First Steps
with
TI-nspire™ CX

Technology for teaching and learning mathematics

Seven Introductory Tutorials for the TI-nspire™ CX Handheld

About this document

This document includes seven introductory tutorials to take new users through many key features of TI-Nspire™ maths and science learning technology. This technology includes both handhelds and computer software, providing teachers the flexibility to meet different classroom needs. However, the primary focus of these tutorials is the handheld device. All activities are equally applicable to the computer software but screen shots and key presses relate to the handheld.

About the tutorials

The tutorials are designed to be worked through in order, with later ones building on skills covered earlier. The first time you meet a new technique, there are very detailed instructions about which keys to press – but, as you would expect, the amount of detail is reduced when the technique is used subsequently.
In an Appendix you will find an example that links together several of the applications introduced separately in the tutorials. As well as enabling you to revisit many of the techniques you met earlier, it provides an example of the use of "multiple representations" of mathematical concepts.

References

In the tutorials you will find occasional references to documents that are supplied in electronic form with your TI-Nspire handheld.

They are also available from **http://education.ti.com/guides**, choose TI-Nspire technology.

They are:

- Getting Started with the TI-Nspire™ CX / TI-Nspire™ CX CAS Handheld
- TI-Nspire™ Reference Guide
- TI-Nspire™ Technology Version 3.0 Release Notes

Key features of TI-Nspire™

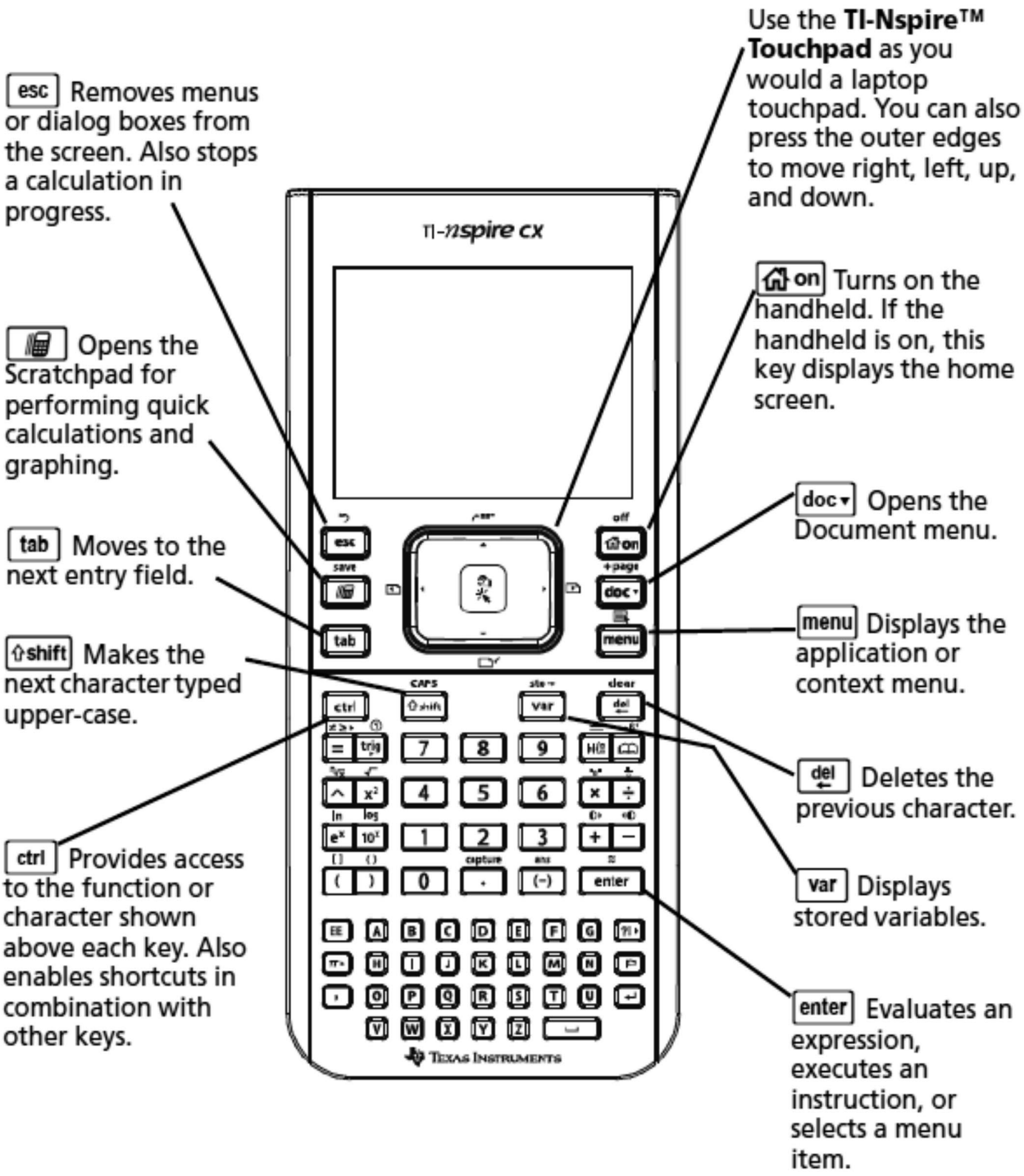
- Multiple representations, dynamically linked, encouraging different approaches to solving problems and expressing solutions.
- A complete set of mathematical tools for algebra, geometry, number, calculus, statistics, matrices and vectors, finance and real-world data logging.
- Working documents which can be saved, recalled, edited, transferred between handheld and computer and distributed electronically.
- A tool for key concept and key skill development across all the secondary school years.

First edition, November 2007.
Second edition, February 2008.
Third edition, August 2008.
Fourth edition, June 2010.
Fifth edition, September 2011.
Sixth edition, January 2012.

Contents

TI-Nspire CX Keypad Layout

Start by spending a few seconds looking at the layout of the keypad.



Tutorial 1

TI-Nspire Documents

This first tutorial introduces some of the key features of TI-Nspire™ learning technology, in particular the structure of TI-Nspire documents, with different applications operating on different pages. The various menus are introduced, as well as creating and navigating around documents. The tutorial assumes that you are using the TI-Nspire handheld device and the tutorial begins by drawing a comparison between this and other types of technology.

Is it a calculator? Is it a computer? ….It's a handheld device!

Pick up the TI-Nspire handheld device and, if you are used to using a calculator, particularly a Texas Instruments TI-83 or TI-84 graphics calculator, you are likely to feel a certain reassuring familiarity: there's a screen and a keyboard laid out in a fairly familiar way. As with many calculators the **on/off** switch is in the top right corner. So press [on] to switch on.

Nothing on the screen?

See *Getting Started with the TI-Nspire Handheld, Recharging the Handheld*

Please don't worry about what's on the screen for the moment, but think about how to switch it off. The [on] key has "off" written in light blue above it so that's the one to use after pressing the blue key marked [ctrl].

But just a minute, it was a key marked **2nd** that you used on the calculators, and the change to the use of a **ctrl** key is quite significant. The designers at TI have moved to making this device much more like a computer and it has a ctrl key, [ctrl], and also a shift key [shift]. Many of the main keys on the handheld have second functions written in blue above the key and these are activated using the ctrl key. Notice for example [x²], [÷] and [var]. The ctrl key can be used in conjunction with the alphabetic keys to create keyboard shortcuts just as you are used to doing on a computer. For example, you can copy and paste using [ctrl][C] and [ctrl][V]. There's also that most useful keyboard shortcut for undoing a previous action, [ctrl][Z], which can also be activated by pressing [ctrl][esc][(][↶][)]. (See Getting Started guide, Using Keyboard Shortcuts for a full list).

Memory

Just like a computer, documents can be stored on the TI-Nspire CX handheld – The TI-Nspire™ CX handheld comes equipped with 192 MB of memory Of the total memory, 128 MB is dedicated to document storage. As documents are created and stored they take up space on the handheld's memory so you may find that every now and again you need to free space on memory after long-term use. If there isn't enough memory on the handheld, you can do one of the following:

- Back up documents and folders to a computer or another TI-Nspire CX
- Delete documents and folders you no longer use
- Reset the memory, which deletes all files and folders on the handheld

Battery Life

The TI-Nspire™ CX handheld comes with a rechargeable battery, which should be charged for at least six hours before first use. The built-in rechargeable battery does not need to be removed from the handheld in order to recharge it. The handheld will still work and can be used while it is charging.

With use of 2 hours per day at the default brightness level the battery should last for up to 10 days.

The handheld comes with the following cables:

- Standard mini-A to mini-B USB cable for transferring files between handhelds
- Standard A to mini-B USB cable for transferring files to and from a computer and for charging the battery via the USB port

Charging the handheld

To charge the battery in the TI-Nspire™CX handheld:

- Connect the handheld to a computer using a standard A to mini-B USB cable. If the driver is not found when the handheld is connected to the computer download the software that includes a driver from **http://education.ti.com/software**.

OR

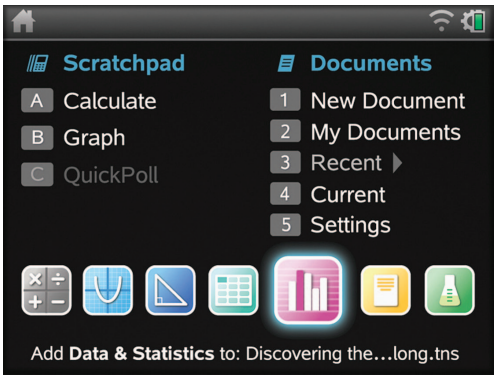
- Connect to a wall outlet using a TI wall adapter (sold separately).

OR

- Place the handheld or multiple handhelds in a TI-Nspire™ CX Docking Station.

The Home Screen

When you switched on a calculator you expected to see what was called the **Home Screen** and you'd be able to start carrying out calculations right away. But the TI-Nspire handheld is different in this respect too. Press [on], the home button, a black key at the top right of the keypad. You should see a screen similar to this. Navigate to the various icons on the Home Screen using the large square **Touchpad** on the keypad. This behaves as both a touchpad (like using a laptop), and as a navigational device as you can press on the up, down, left and right arrows to move the selector around. To click or select something you press the [ctrl] square symbol in the middle of the touchpad, or press the enter key. However don't select anything else yet!



Consider whether the TI-Nspire's home screen is more reminiscent of a calculator or of a computer. When a computer wakes up you first see the desktop and in many ways this TI-Nspire Home Screen is similar. With a computer you have to choose an application to use -- a word-processor, spreadsheet or whatever. You then must open a document within which you will be able to write text, do calculations, manipulate images etc.

Computer: Desktop ➔ Choose Application ➔ Open Document

In many ways working with TI-Nspire is similar. You always have to work within a document and you can use different applications to calculate, draw graphs, , work with geometry, manipulate lists and spreadsheets, work with data and statistics, add notes and perform data logging.

The TI-Nspire applications are:

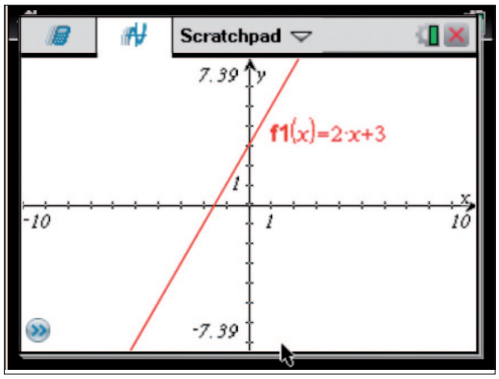
- **Calculator** 
- **Graphs** 
- **Geometry** 
- **Lists & Spreadsheet** 
- **Data & Statistics** 
- **Notes** 
- **Vernier DataQuest™** 

What is quite different from the computer is that within one document you can have multiple pages or problems that can make use of the different applications. The spreadsheet on one page of a document can interact seamlessly with calculations done on a calculator page and graphs drawn on another. You can also have more than one different representation on one page.

This use of multiple representations is one of the many things that make the TI-Nspire such a powerful tool. So with TI-Nspire you first open a document, or start a new one, and then choose an application.

TI-Nspire: Home screen ➔ New document ➔ Choose application

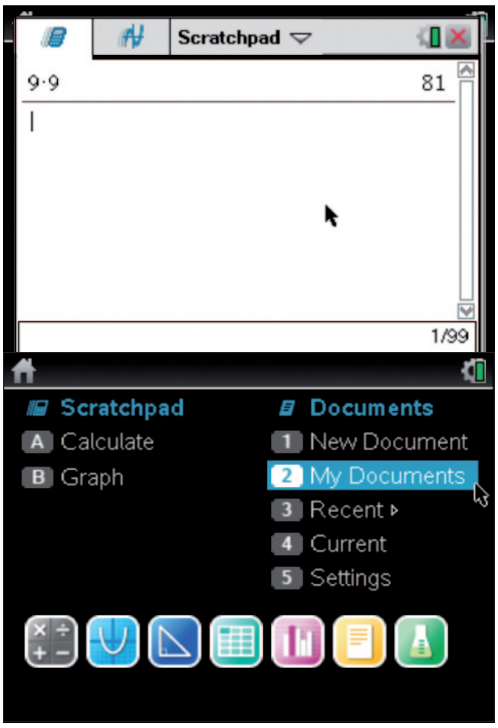
TIP: If you would like to return to the document you are working on without inserting a new page, from the Home screen select option **4: Current**.
You can do this by pressing 4 on the keypad.



Scratchpad

Because there are some occasions when you really just want to carry out a quick calculation or draw a quick graph the TI-Nspire includes a feature called the **Scratchpad**. The scratchpad is designed for those casual throw-away calculations that need to be done from time to time, but are not worth keeping in a full document. To access the Scratchpad press [doc].

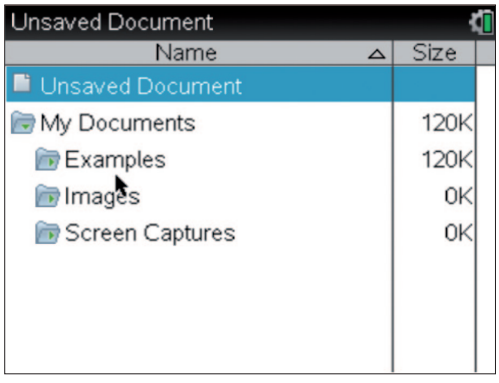
This opens a calculator page for performing quick calculations. Pressing [doc] again swaps between the calculator and a graph scratchpad page. To close the Scratchpad simply press [esc].



Documents, Problems and Pages

In order to see what documents are pre-loaded on your handheld you need to use option 2 on the Home screen: **My Documents**...

Either use the touchpad to move the selector down to the **2: My Docs**... option then press [doc] to select it.
Or use the touchpad to move the cursor over option 2 and [doc] Or just press [2] key to select option the 2nd option.

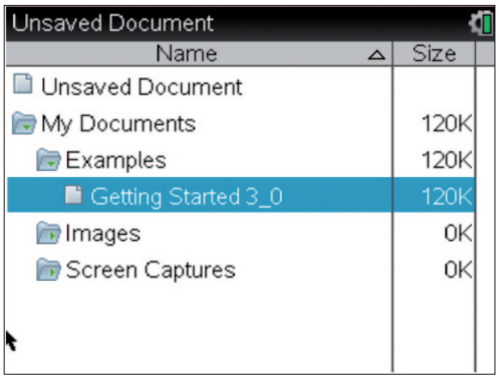


You should see a screen called the Document Browser and it will be something like the one shown here. Documents are organized into folders as they would be on a computer. A new TI-Nspire handheld should have a folder called **Examples**:

Tip: You can use either [doc] or [enter] as alternative key presses

Move the cursor to the folder entitled **Examples**.
Then press [doc] or [enter] or ▶ on the touchpad to open the folder.

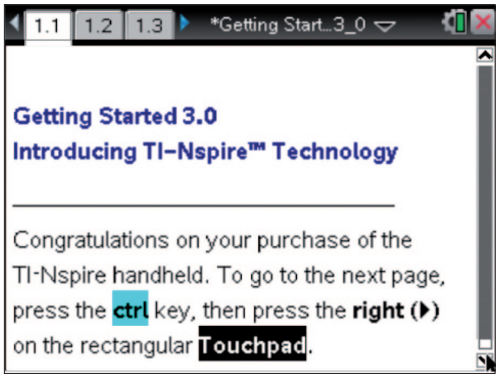
Inside the **Examples** Folder on your handheld you will probably find a document entitled 'Getting Started 3_0'.
Use ▼ to locate and [enter] to open the document.



If the handheld has been used previously you will see a dialog box asking you if you want to save the document that is currently open. Unless you want to save your previous work press tab or ▶ to move the highlight to No. To confirm this choice press enter.

tab is often used to move to and highlight different parts of the screen

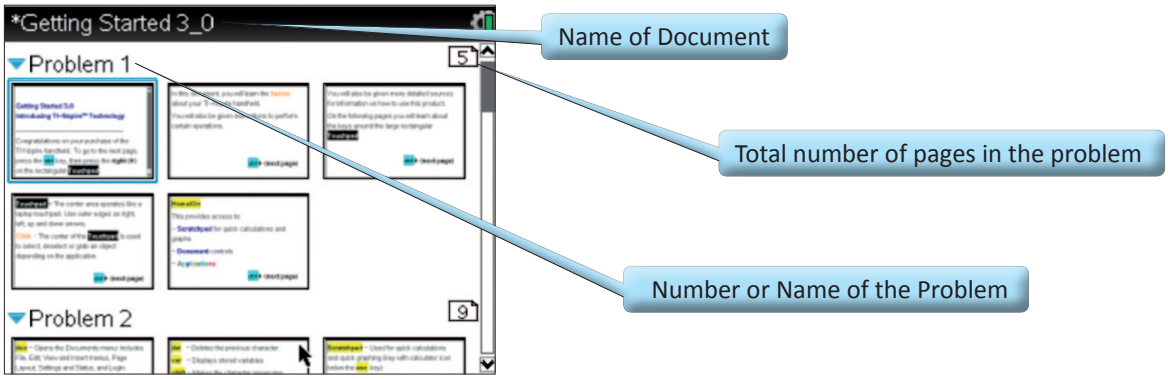
Navigating Documents



When the document opens you may see a screen similar to the one shown on the left. For the moment, please do not follow the instructions on the screen just yet! Continue working through this tutorial, which will introduce you to many of the key features of the TI-Nspire document model.

Among these key features are useful and easy ways to navigate through documents. For example, pressing ctrl ▶ will take you to the next page in a document. Similarly, pressing ctrl ◀ returns you to the previous page. Pressing ctrl ▲ will take you to the Page Sorter which enables you to move quickly and easily through the pages of a document.

Notice the information typically provided on the Page Sorter:



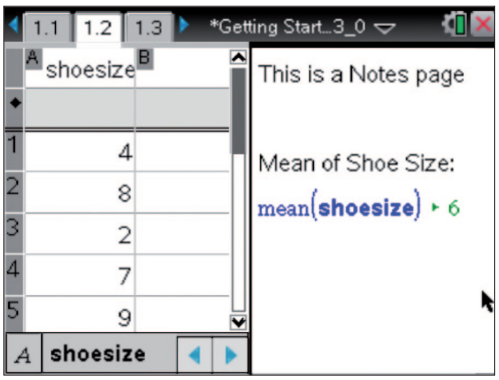
A TI-Nspire document can consist of multiple problems and each problem can consist of multiple pages. For example, the document shown here consists of at least two problems, with 5 and 9 pages respectively.

Scroll downwards with the Touchpad and you will see all the problems in the document. If you move the highlight onto Problem 2, say, and press ◀ the pages of that problem will close up. Pressing enter or ctrl ▼ takes you back to single page view on the page currently selected.

Each page of a document contains one (or more) of the TI-Nspire applications.
As a reminder, these are the same applications that can be accessed from the Home screen, i.e.:

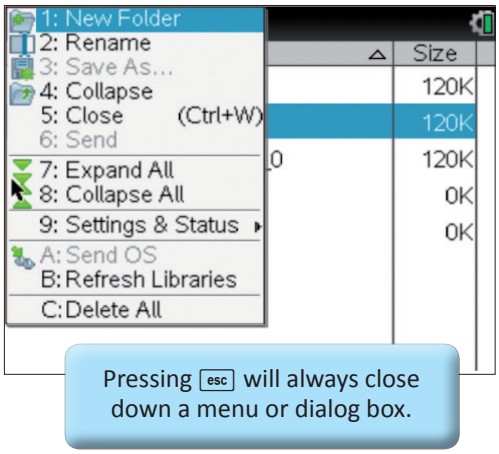
- **Calculator** 
- **Graphs** 
- **Geometry** 
- **Lists & Spreadsheet** 
- **Data & Statistics** 
- **Notes** 
- **Vernier DataQuest™** 

The use of each of the applications which you might want to use for data logging is covered in the tutorials that follow. Any page can be divided into as many as four work areas, allowing up to four different applications to be used per page. To do this, See 'Splitting the Screen' in Tutorial 3, page 23.
Shown here is a page that has been split into two with the **Lists & Spreadsheet** application on the left, and the **Notes** application beside it.



If the 'Getting Started 3_0' document is present on your handheld, work through it now as far as page 2.5. This will allow you to revise what has been covered so far in this tutorial

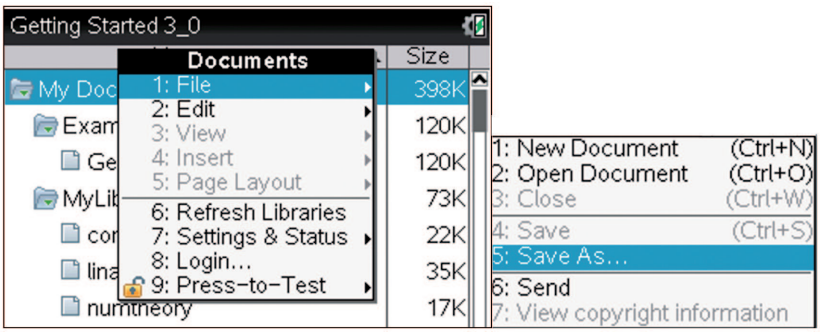
Contextual Menus



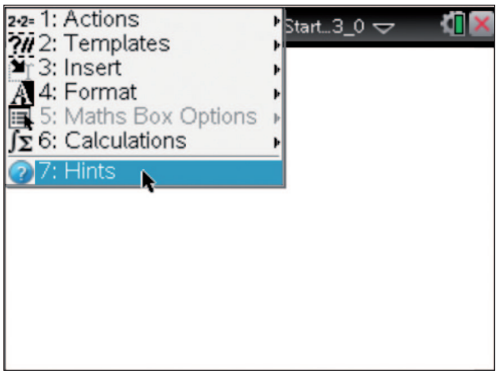
Return to the Home screen, and select **2: My Docs**… to access the document browser. Notice that within the document browser new folders may be created or folders renamed. Items that are grey, rather than black in a menu cannot be chosen in the current environment. For example, on the screen on the left, option **3: Save As**… is unavailable.

To save a document under a new name press doc▾.

This opens a menu providing access to document management features. By pressing 1 and then 5 the document can be saved under another filename.



Then open a document in the browser and press menu again. It is important to realise that menu will always provide access to the features of the current environment. For example, within the **Notes** application, this menu offers only the available options for that application (as shown to the right).



There are a number of tools that are available for managing documents when you choose the use the **Document** menu by pressing the doc button. Several options are marked by the symbol ▸ and pressing ▸ on the Touchpad opens their submenus.

Within any application, this **Document** menu retains the same features but any options that are currently unavailable are *greyed out*.

The next tutorial describes creating a new document and using a first TI-Nspire application.

Check list of some key points in Tutorial 1:

- Understanding, the terms document, problem, page, application, and home screen
- Use of the ctrl key and keyboard shortcuts
- The Home Screen
- Scratchpad
- Memory
- Battery Life
- The Document Browser to navigate around documents and folders
- The Page Sorter to navigate inside documents
- The use of tab and esc
- Why menu produces different menus in different contexts
- The Document menu

Tutorial 2

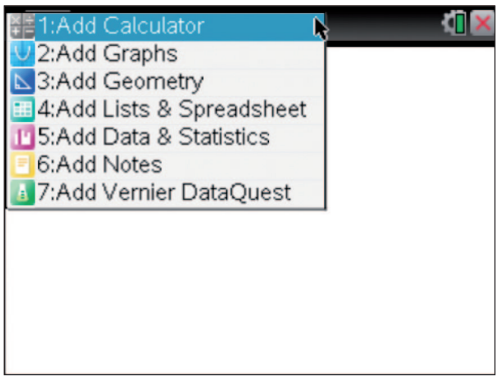
The Calculator Application

At the heart of TI-Nspire is the Calculator application, the workspace for numeric and algebra operations. This tutorial introduces some of the key features of the application, starting with a new blank document. This document will be saved, used again and added to in subsequent tutorials

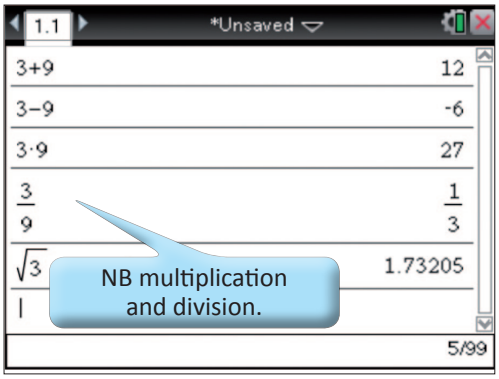
Basic operations

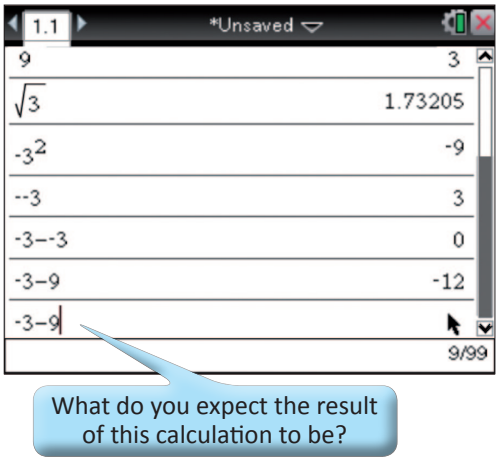
First create a new blank document by pressing [on] and choosing option **1: New Doc** from the Home Screen.
To open a page which uses the calculator application:

press [1] or [enter] or [ ].



Try keying in and entering expressions using the four basic arithmetic operations, square roots, negatives etc. Look carefully at how the expressions as well as the results appear on the screen, in order to understand the conventions the handheld uses with its default settings.





Notice that in many cases the layout of the expression changes when [enter] is pressed—in particular watch how the multiplication and division operations are handled.

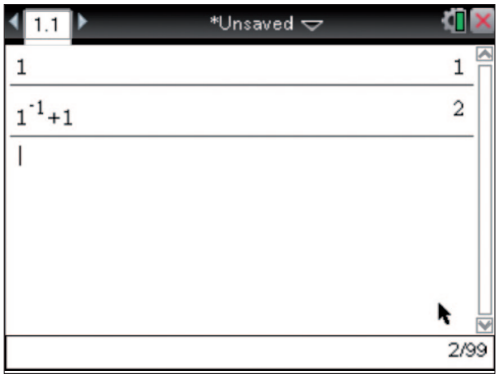
Try typing a lengthy expression and, before pressing [enter], see the effect of using [del] and then [ctrl] [del].

A History Lesson

You will have noticed that, as new expressions are entered, previous ones scroll off the top of the screen. The TI-Nspire handheld will remember a history of up to 99 expressions and these can be recalled using the up key on the Touchpad. Press and hold ▲ and see the way the highlight flicks back through previous expressions and results. Stop at some point in the history and press enter. You should see either the previous expression or the result copied to the entry line ready to be used as all or part of a new expression.

Notice that, after an expression has been evaluated, simply pressing enter again repeats the previous entry. What would you expect to see if you repeatedly pressed enter on this screen? Try it by pressing

1 enter
^ (−) 1 ▶ + 1
enter enter enter ...

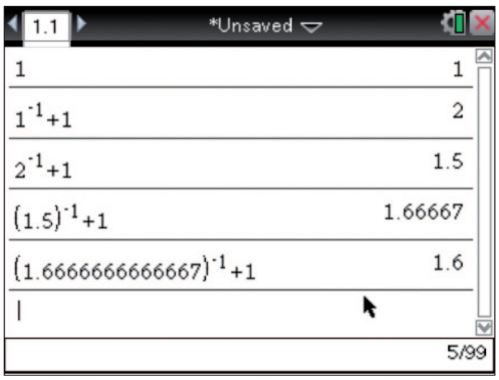


Notice how entering an operation at the beginning of an expression (the power operation in this example) causes the automatic entry of *Ans*, standing for the previous answer.

If you ever need to clear the history there is an option in the Actions submenu: press menu 1 5. This is also a way of producing an uncluttered screen for making screenshots such as the one above.

Approximate Calculations

If you repeat the key sequence above but replace the first enter with ctrl enter you get the rather different results shown here. Try it and continue pressing enter until you get an (apparently) unchanging approximation for the Golden Ratio.



The default mode for calculations is to give exact results (using fractions) rather than approximate results (using decimals). It is possible to alter this using the system settings as you will see later in this tutorial.

Another way of choosing a decimal result is to enter a decimal in the expression that you type, e.g. try entering 1 / 7 and then 1.0 / 7.

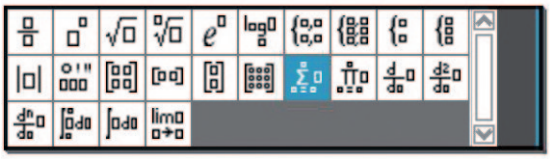
Templates

Many of the handheld's keys provide templates to enable you to enter a range of mathematical expressions. For example, in this tutorial you have used the keys ctrl x² for square roots and ^ for powers. In both cases a small box appears in the expression inviting you to enter values. Some care is necessary when entering more complex expressions using such templates.

For example, try entering √3+√5. In order to move out of the box after entering 3 you need to press either tab or ▶. This explains the use of ▶ in the key sequence in part b above.

More complex templates are available from the Maths Templates Menu that can be opened by pressing ⌨.

To make a selection from this menu you need to move the highlight with the Touchpad and press enter.

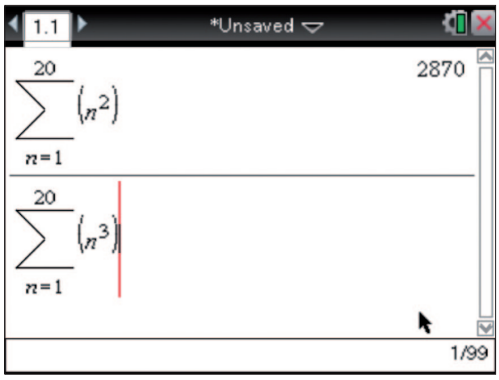


A menu of maths templates

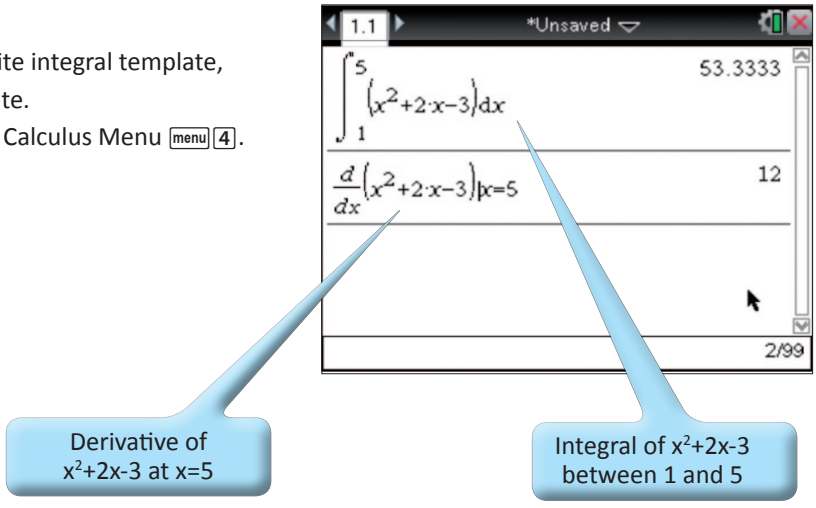
Those options which have a bold T superimposed are not available on the numeric version of TI-Nspire as they require a Computer Algebra System (which cannot be used in most exams).

Try using a template to produce the sums of the first 20 square numbers. You will need to use an alphabetic key such as N to enter the variable name. Press tab or use the Touchpad to move from one small box to the next. Now produce the sums of the first 20 cubic numbers. The easiest key sequence to use is (probably!):

▲▲ enter ◀◀ del 3 enter



Other useful templates are the definite integral template, and the differential at a point template.
These can also be accessed from the Calculus Menu menu 4.



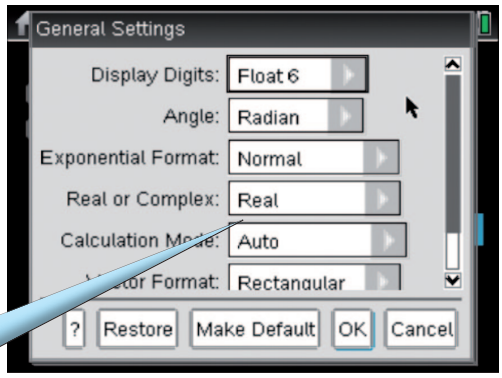
Getting Set

The mode settings for a document can be changed using the document settings dialog box: press

on 5 2 1 or doc 7 2 1 or

Click on the icon then press 2 1

With dialog boxes it is important to remember that you need to press tab to move through the various options.

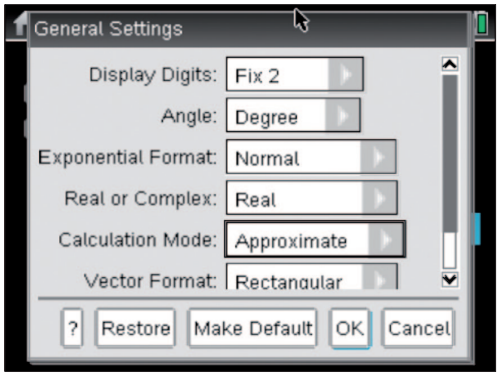


Document settings dialog box

Notice that here the first box is outlined bold, showing that Display Digits is selected. Press ▼ to see the range of options for fixed or floating decimal places. Change to the setting **Fix 2**, by highlighting it and then moving to the next box using tab.

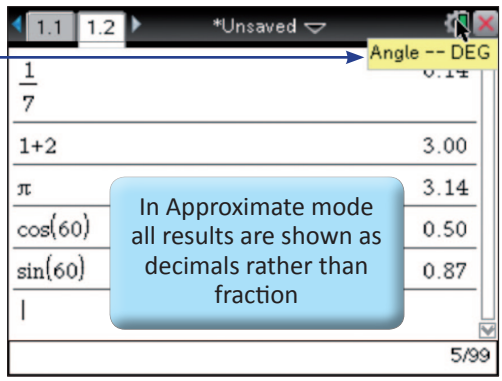
In the second box, change the angle setting to **Degree** and in the fifth box choose **Approximate**.

Then press enter again to apply the new settings to your document.



You can check the angle setting by hovering the cursor over the symbol.

Do some calculations to see the effect of these changes before returning to the default settings, **Float 6**, **Radian** and **Auto**.



The effect of changed settings

Some Algebra

The calculator application allows you to define variables as single numbers, functions, lists, matrices and even strings.

There are three equivalent ways to store a variable.

You can use [ctrl] [var] (store),

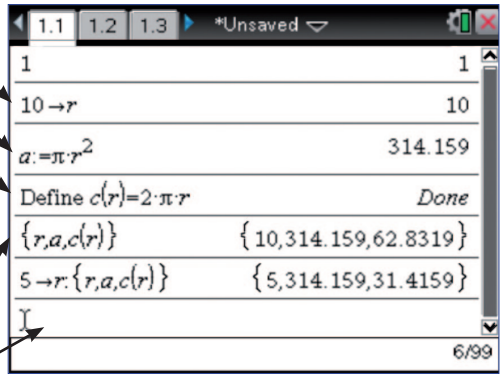
or [ctrl] [÷] (:=)

or Define

Define can be typed letter by letter, followed by a space or alternatively it can be entered from the Catalogue: press [doc] [D] to find it.

Notice also you can:

- display multiple values in a list using curly brackets [ctrl] [)];
- use a colon for multiple statements on the entry line [?!].



3 ways to define variables

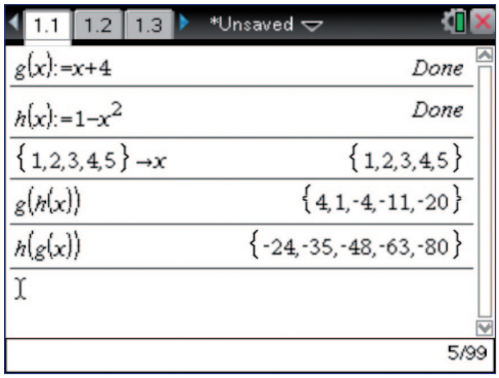
In the last entry the value of r was changed to 5 but notice the difference between a and *c(r)*: whereas *c* is a defined function of *r, a* had been given a particular value.

What you type is not necessarily what you get: above πr² and 2πr were a ctually typed as.

[P] [I] [×] [R] [x²]
[2] [P] [I] [×] [R]

This screen illustrates the use of function notation on the calculator screen. Notice that h(g(x)) can be evaluated numerically but the TI-Nspire CAS would be able to evaluate it algebraically.

You will see in Tutorial 4 that functions defined like this in the Calculator application can then be used in the Graphs and Geometry application. So please enter these definitions of g(x) and h(x) on your handheld now.



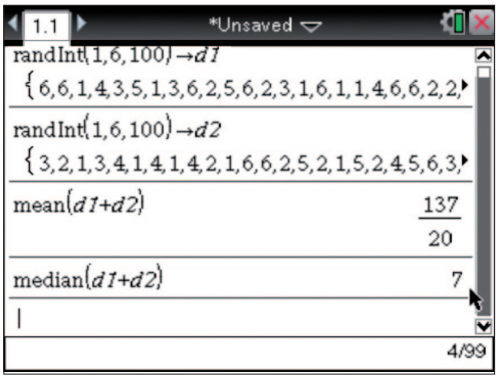
Use of function notation

The Calculator Menu

Press menu and look at the extensive system of menus and submenus available in the Calculator application. If you used the TI-83 or TI-84 graphical calculators you will be familiar with many of these expressions.

More details can be found in the Getting Started Guide.

This screen shows a simulation of 100 throws of two dice and uses commands from the Probability and Statistics sub-menus.



Lists of random integers

To enter **randInt** you can either press

menu 5 4 2

to navigate through the menus or you can spell it out, letter by letter.

You will find the **mean** command by pressing

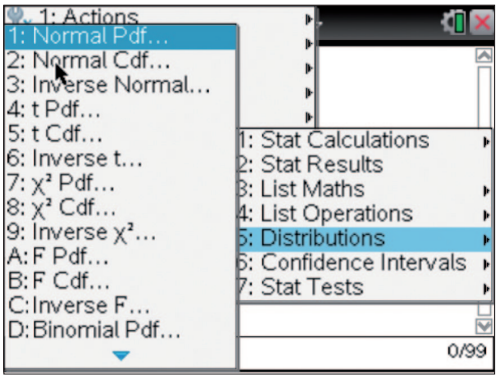
menu 6 3 3 del

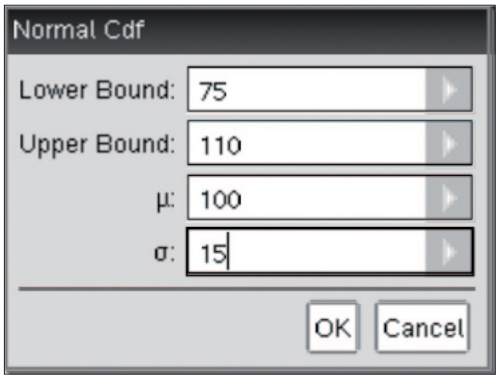
Notice that the expression d1+d2 produces a list of 100 sums of the corresponding values from d1 and d2 i.e. 100 totals when 2 dice are thrown

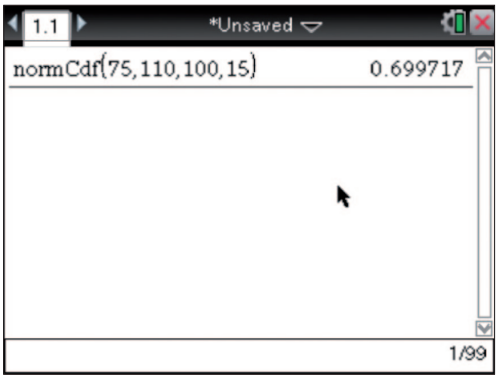
Statistical Distribution Tables

A useful feature of the TI-Nspire is the ability to work with probability distributions such as the Binomial, Poisson and Normal distributions. These can be found by pressing menu 6 5.

These provide wizards which enable you to calculate the probability for a given distribution instead of looking up the value in a table.







Variables Linked to Documents

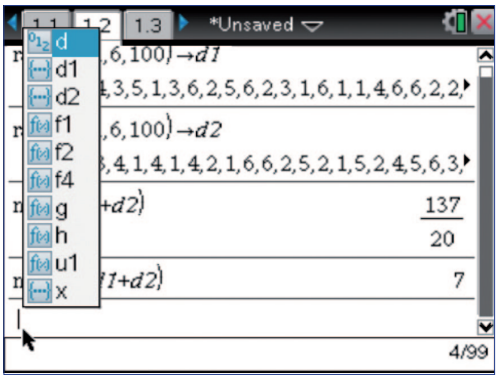
Press [var] and you will see a floating menu showing all the variables that you have defined while using the current document.

When you load a different document these definitions will be replaced by those linked to that document. Make sure your list includes the variables g, h, d1 and d2 and then save the document, giving it the name **FirstSteps**.

The Save As.. option is in the Documents menu so press [doc] [1] [5], type the filename:

[shift] [F] [I] [R] [S] [T] [shift] [S] [T] [E] [P] [S]

and press [enter].



List of defined variables

Check list of some key points in Tutorial 2:

- The layout of expressions often changes when they are evaluated
- Previous expressions and results can both be recalled for subsequent use
- Evaluation can be either approximate (decimals) or exact (fractions)
- How to use templates and menus
- Changing from default document settings
- Using Statistical Distribution functions
- Defining and using variables and functions

Tutorial 3

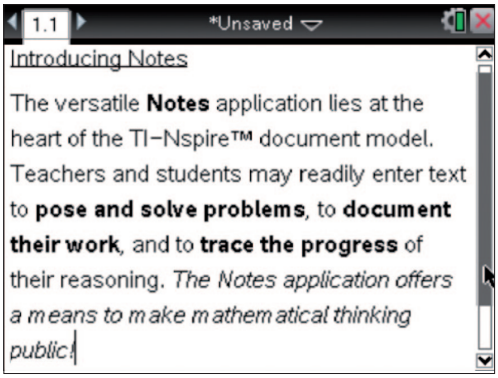
The Notes Page

This very short tutorial introduces this simple, innovative application and deals with the process of splitting the screen.

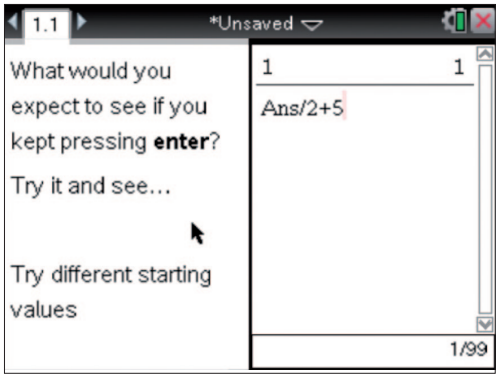
Why use Notes?

TI-Nspire documents may be readily shared with others, so teachers can prepare and then distribute documents that are a type of electronic worksheet. The Notes application allows documents to include:

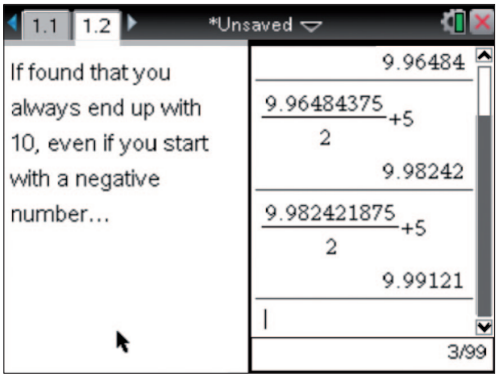
- text instructions for the user
- space for the user to document their own mathematical activities
- a means of teacher-student and student-student interaction.



Various text formatting



Instructions



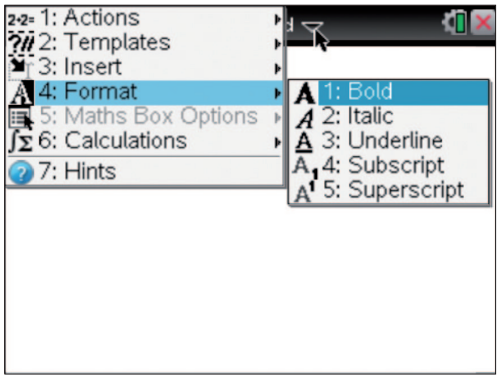
Recording results

Making Notes

Open a **FirstSteps** document that you created previously.
Open a new page for notes in that document by pressing [on] and then selecting  .
Alternatively a Notes page can be added by pressing [ctrl] [doc] [6] or by pressing [(] [+page] [)].
Enter some text using the alphanumeric keys. For upper case letters use the shift key, [shift].

Press menu to see the various options available when using the **Notes** application.

Try to format some text.



The Format sub-menu

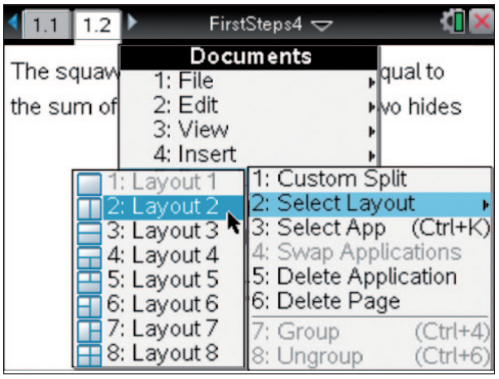
To select a block of text for formatting hold down the shift key, shift, while you move around the text using the Touchpad.

Splitting the Screen

In any application you can split the screen into two or more parts using the **Page Layout** option in the Document menu.

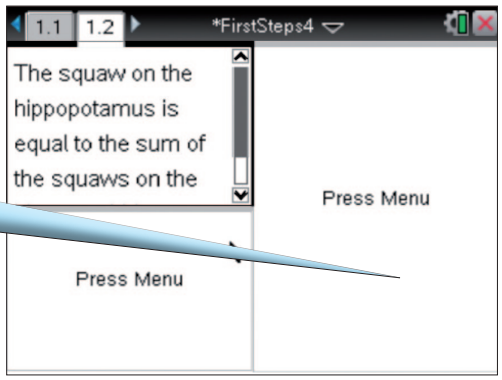
Press doc 5 2 and you should see the various standard options available. The icons on the left of the menu indicate the way the screen will be split.

Choose any of the options to see your text appear on a split screen.



Ways to split the screen

Important: to move from one part of the screen to another you need to press: ctrl tab



You must press ctrl tab and then menu

Add a Calculator application area to your page and experiment with using **Notes** and **Calculator** together.

The option **Custom Split** enables you to change the width or height of sections of the page. It can be used either when the page is first being split, or subsequently to edit an existing split page.

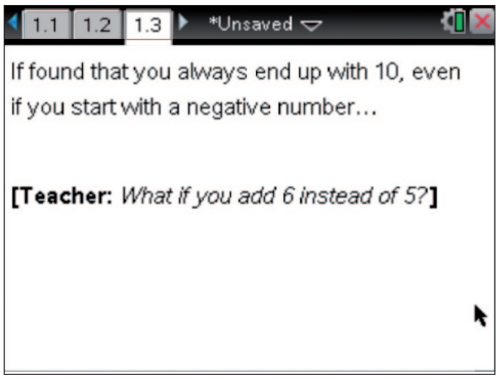
More Options from the Notes Menu

Mathematical expressions can be entered (and evaluated) on a **Notes** page.

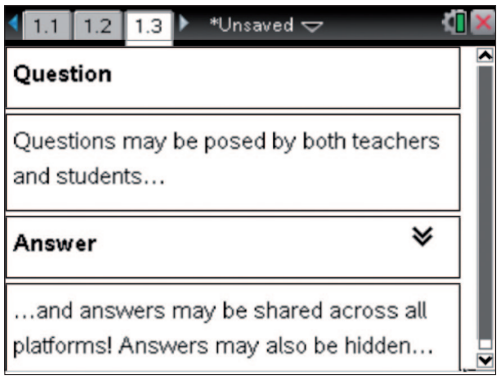
In addition the menus in the Notes application provide:

- two templates for Q+A and Proofs
- teacher and reviewer comments
- small shapes such as Δ

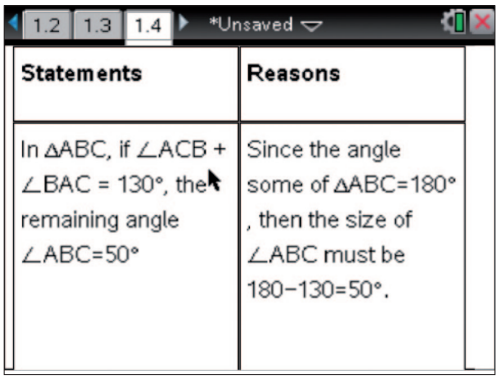
Have a look at the examples of their use shown here. If you want to explore them choose the relevant options after pressing menu.



An inserted comment



Use of Q+A template



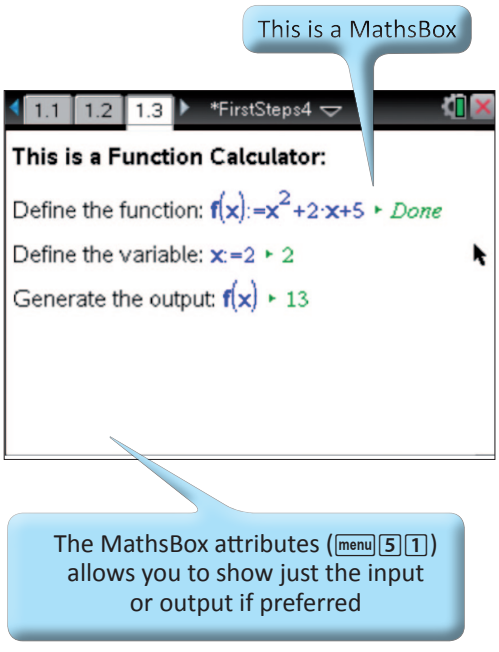
Use of proof template and symbols

Interactive Notes

A powerful feature of the Notes page is something called Interactive Notes. These enable you to create dynamic calculations. Unlike the **Calculator** page, which when you carry out a calculation gives an answer which will not update, the **MathsBox** within the Notes page is dynamic.

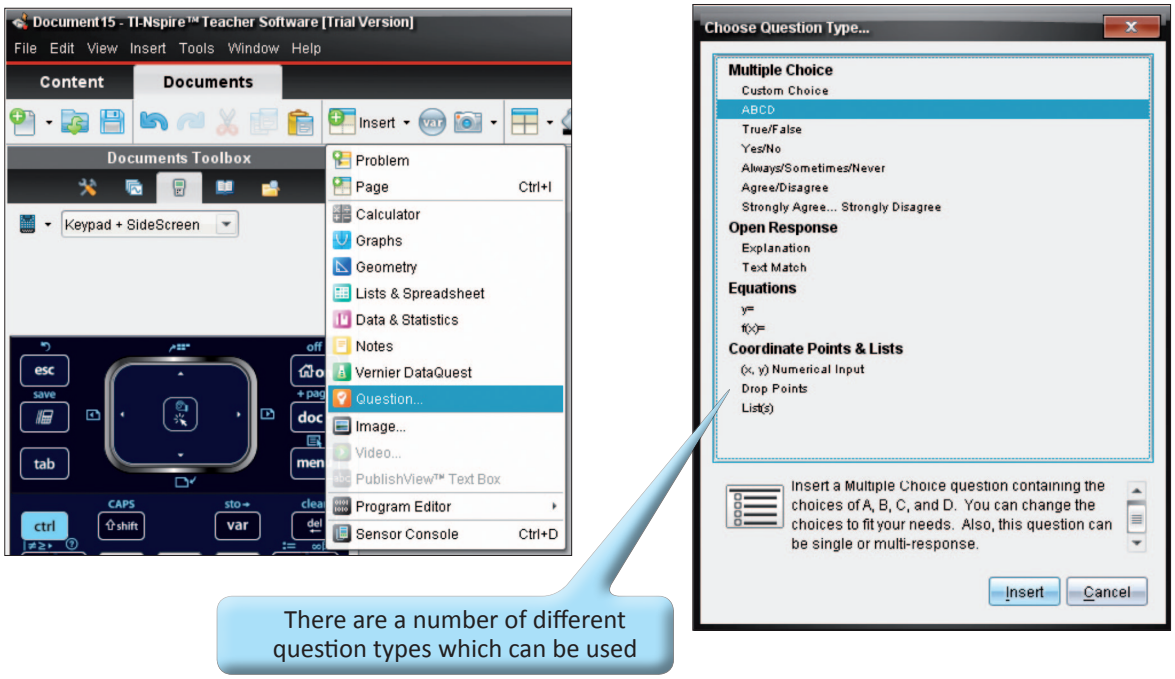
Add a new Notes page by pressing:
ctrl doc 6. For this simple example we will create a function calculator.

To do this simply add a MathsBox (menu 3 1 or ctrl M) and enter the calculation exactly as you would have done on the Calculator page (i.e. the bold text in the image). Now try editing either the function or the input value, and see how the output automatically updates.

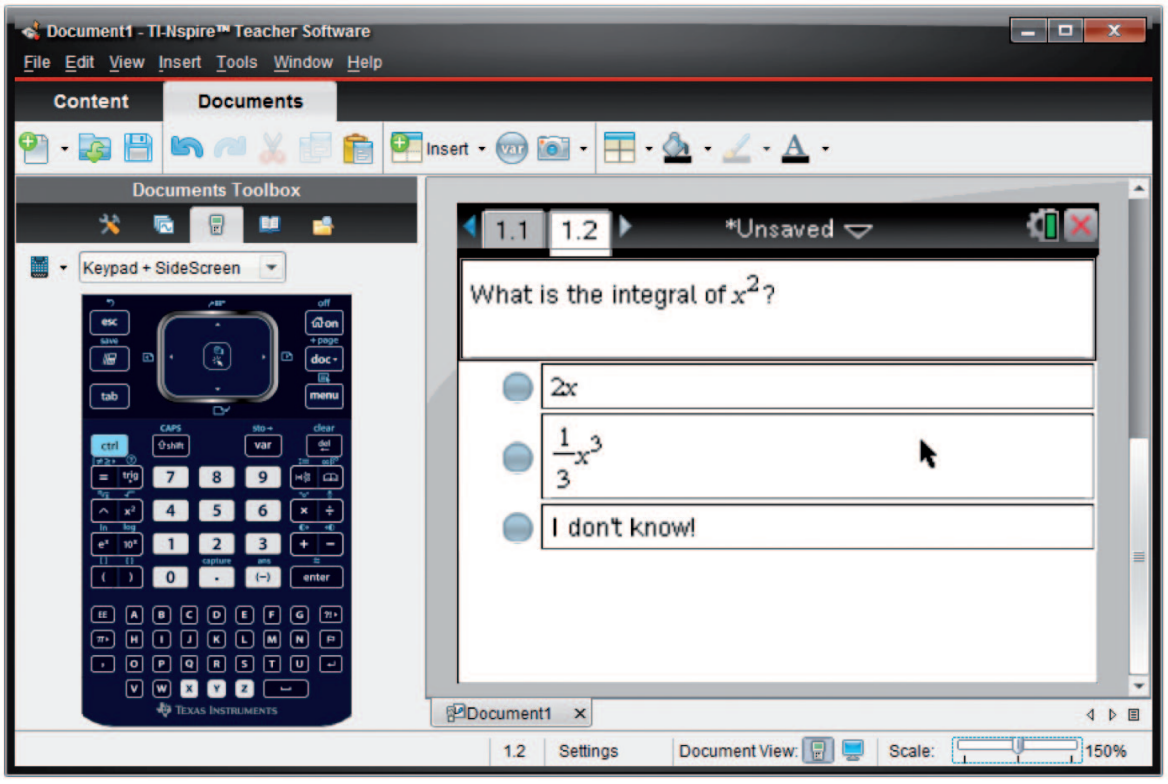


Asking Questions

If you also have access to **TI-Nspire Teacher Software**, then you also have the ability to insert questions in to your documents. To do this you use the Insert menu and choose **Question**...

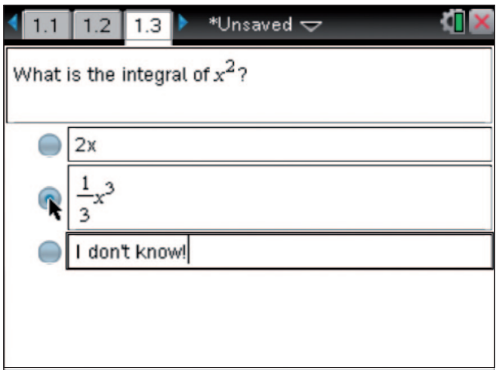


In this example we've chosen the **Custom Choice** question type, this is a multiple choice template.



We then enter the question in the top box and answers in the fields below. To add mathematical content insert a Maths Box. To indicate the correct answer click on the Tick mark.

When viewed on the handheld the question this will look like this. If the correct answer has been set then the question can be either self-marked by pressing menu 2, or marked by the teacher using **TI Connect-to-Class or TI-Nspire Navigator Teacher** software.



Check list of some key points in Tutorial 3:

- Some possible uses for the Notes application
- Creating and editing page layouts with split screens
- Moving from one part of a split screen to another
- Accessing templates from the Notes menu
- Using Maths Boxes in Interactive Notes
- Creating question using the TI-Nspire software

Tutorial 4

Graphing

The Graphs and Geometry applications are probably the most visually exciting of the TI-Nspire applications. This tutorial introduces the Graphs application and then concentrates on its use for graphing and exploring functions. The application's use for creating and exploring geometrical shapes is covered in Tutorial 5.

Graphs & Geometry: Two Views

Start by opening the document **FirstSteps4** that you created in Tutorial 3. Press [on] then select  to create a new page with the Graphs application. You should see the Graphing View, with the coordinate axes defined by the default window settings and an entry line at the bottom of the screen.

A Graphing page can be turned into a Plane Geometry page by pressing [menu][2] to open the View menu and [2] to choose the Plane Geometry View. This view has no entry line or axes and is ideal for drawing geometrical shapes. Tutorial 5 will explore this aspect of the Graphs & Geometry application.

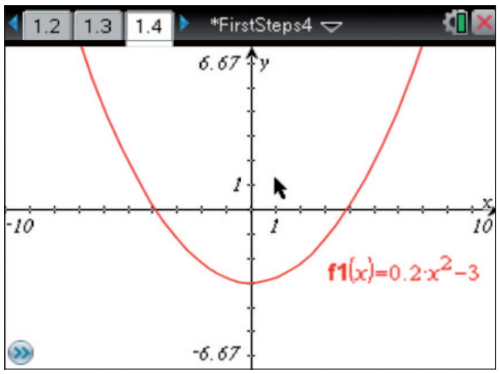
Return to the View menu and notice that several options are now grey, indicating that they are not available in this view. Choose [menu][2][1] to return to the Graphing View.

Graphing Functions

Alongside ***f1(x)=*** enter $0.2x^2-3$ ([0][.][2][X][x²][−][3]) to see the screen shown here.

Notice the label that appears alongside the function's graph and the way the entry line has now disappeared.

In Tutorial 2 you defined the function g(x):=x+4. Press [tab] to return the entry line and alongside ***f2(x)=*** enter g(x) ([G][(][X][)]) and draw the straight-line graph. Notice that the entry line will again disappear.



The Graphing View

Pressing [tab] once again will return the graph entry line, pressing [tab] repeatedly and the highlight moves to different locations on the screen. Highlight the double arrow in the bottom right-hand corner and press [enter]. This enables you to see all the functions entered so far—the function history. Press [esc] and you move to the main work area with a cursor in the form of an arrow at the origin.

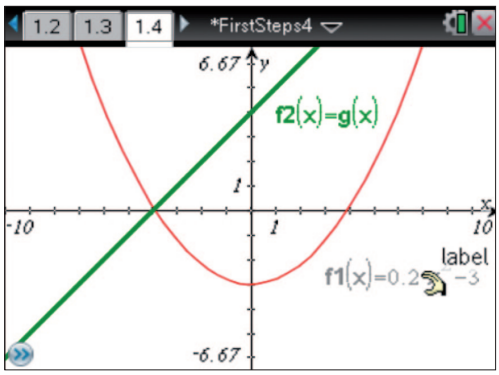
Grab and Drag Practice

Use the Touchpad to move the arrow around the work area, it behaves exactly like a trackpad on a laptop, so you do not need to press down on the pad just let your finger lightly touch it.
As you move the cursor over the objects in the work area, three things may happen:

- the cursor changes shape
- the underlying object flashes
- labels of the various objects appear, e.g. axes, graph etc.

In some positions two or more screen objects overlap and you are prompted to press the tab key to toggle through the labels of various overlapping objects. Move the cursor to the position shown here.

Make certain that the open-hand icon is showing over the highlighted label for f1(x) and grab the label by pressing and holding or by pressing ctrl.



The open-hand cursor

Notice that the fingers of the hand close up indicating that you have successfully grabbed this label. Use the Touchpad to drag the closed-hand icon and the function label to a new position. Click again by pressing or press esc to stop dragging. Being able to grab and drag items is one of the most powerful features of the Graphs. However, some skill and patience is often needed to grab exactly the right item and, without care, mistakes can easily be made.

If you do end up moving the wrong item, remember that ctrl Z or ctrl esc can be used to undo the last change. As with a computer ctrl Y can be used to redo.

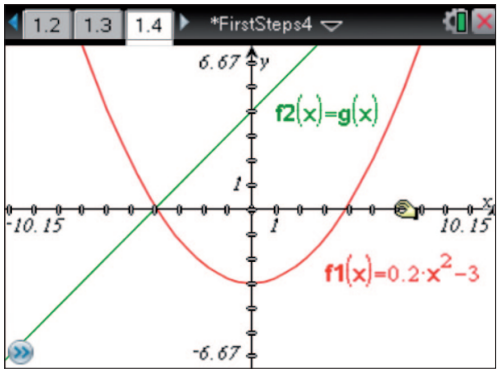
Changing the Axes

Get some more practice at grabbing objects as follows. Move to a tick mark on the x-axis such as the one shown here representing x=6. Make certain that you can see the open-hand icon – if you see an upward pointing index finger you are selecting the axis itself, not just the tick mark.

Grab the tick mark and move gently to the left or right watching the effect. Notice that both the x- and y-axes are rescaled.

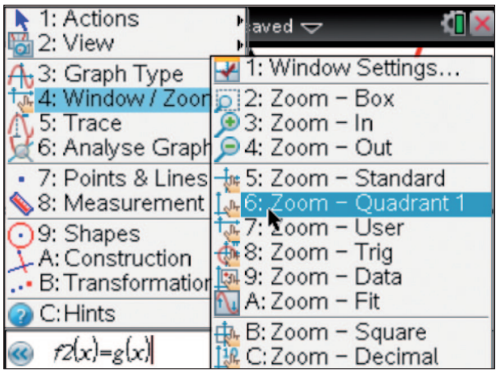
Click again ( ) or press esc and ctrl esc to undo this and return to the default set of axis.

Now grab the tick mark again and this time hold down the shift key, shift, while you move left or right. This time the x-axis is scaled but the y-axis is unchanged.



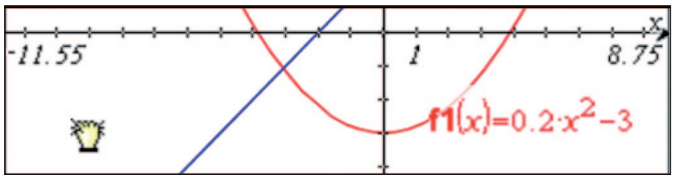
Grabbed tick mark on the axes

You have just used a direct method for changing the axes, but there are a number of other ways to do this. Press menu 4 and you will see this Window sub-menu. Option 1 allows you to enter numerical values to determine the extremes of the axes, while the Zoom options, as on the TI-83 and TI-84, provide automatic rescaling.



The Zoom settings

It is worth mentioning one final very useful way of changing the position of the axes, but without rescaling them. Move the arrow cursor to an empty part of the screen and grab the vacant space. An appropriate icon appears (✋) indicating that you are grabbing the whole working area. Now you can use the Touchpad to reposition the axes as you wish.



The grabbed-sheet icon

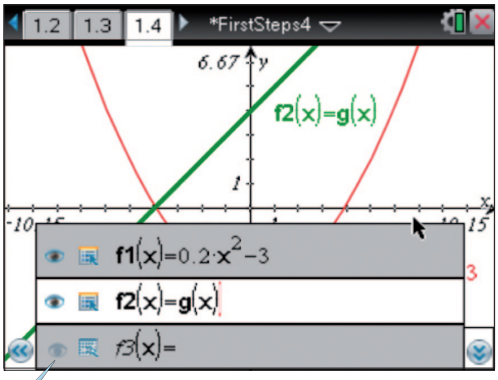
Reset the axes using the (default) **Zoom-Standard** option from the Window menu before continuing.

Editing, Deleting or Hiding a Function

Suppose you wish to make f2(x)=x+8. As well as changing g(x) in the Calculator application on page 1.1, you can make the change in two ways on this page.

- In the work area, move the pointer to the label, f2(x)=g(x) and, instead of grabbing it, double-click on the label and an editable box opens up. Change the definition and press enter to update it.
- Press tab tab enter to highlight the function history area and scroll up to edit f2.

Functions may be deleted in similar ways, by simply deleting their definition and pressing ·.

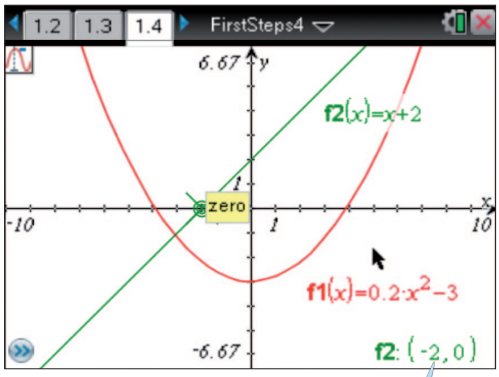


Changing f2 in the function history

To hide a function's graph click on the Hide/Show button

Tracing Graphs

Press menu 5 1 to choose the Graph Trace option.



Trace picks out significant points

Notice the Trace icon in the top left corner of the work area. This is typical of many of the options from the menus.

The current value of the trace is displayed in the bottom corner

Press ◀ and ▶ to trace along the graph and see the coordinates of current points in the lower right corner. For intricate functions progress can be slow along the curve but you can change the Trace Settings to increase the Trace Step: press menu 5 3 and try a step of 0.5 or 1. To start tracing at an integer value of x, in Graph Trace mode simply type the integer and press enter.

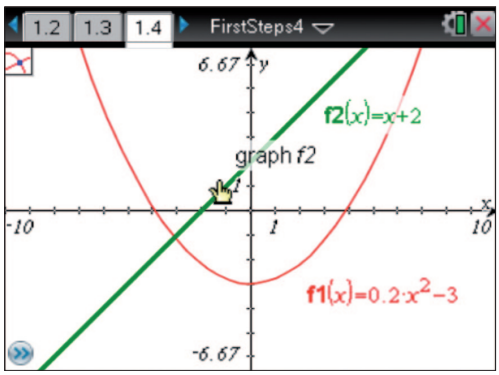
Press ▲ or ▼ to move to the other graph. To trace through all the visible functions at once use **Trace All** menu 5 2. Notice that significant points such as maxima, minima and zeros are automatically identified.

To stop tracing you need to press esc. Check to see that the Trace icon is no longer showing in the top left corner.

Points and coordinates

Here is the way to mark points of intersection of two lines.

- Press menu 7 3 to choose the Intersection Point(s) option. Notice the icon has appeared in the top left corner.
- Move the cursor to the graph of f1(x). With the graph highlighted click ⬚.
- Move to the graph of f2(x). With the graph highlighted click ⬚.



Points of intersection

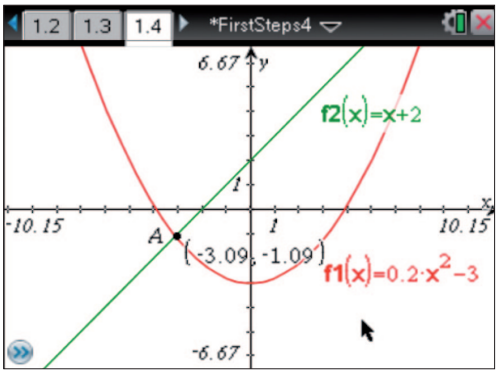
Notice that the Intersection Points icon is still visible so you can go on to mark more intersections. For example you could try marking where the two graphs cross the y-axis.

Now press esc.

Notice that all the intersections are added at once and that their co-ordinates are automatically displayed.

We will now use the Text tool: menu 1 6. Try labelling one of your fixed points by moving carefully to the point—make quite certain that only the point is highlighted and not one of the graphs or axes.

Points, lines and shapes can be drawn and manipulated on the graphing work area and this will be explored in the next tutorial. However, one more thing to try now is putting a grid on the work area. Press menu 2 6.

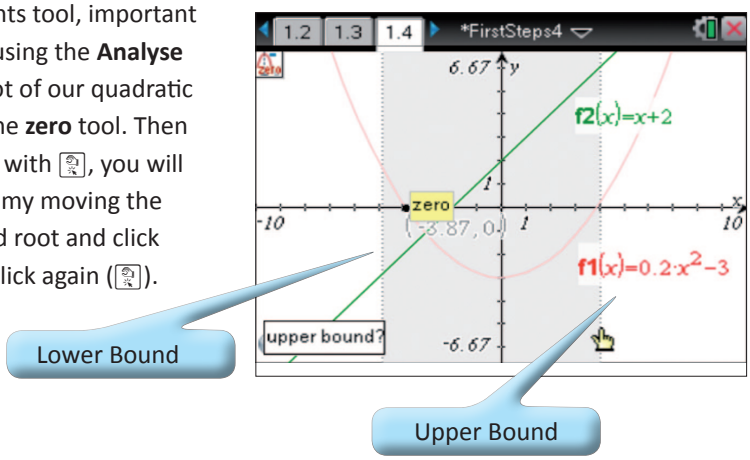


Coordinates and labelled points

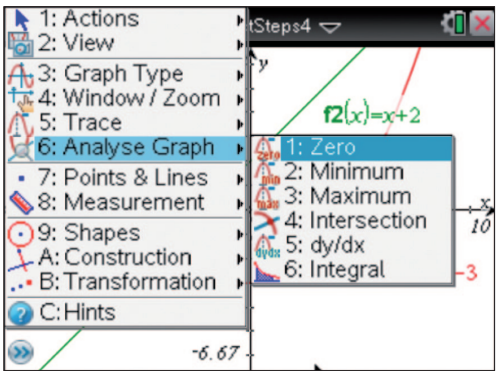
It's easy to change the number of decimal places displayed: move the cursor over a displayed value and press − or +.

Analyse Graph Menu

As well as tracing graphs and using the Points tool, important points on graphs can also be identified by using the **Analyse Graph** tool. We will find the right-hand root of our quadratic function by pressing menu 6 1 to activate the **zero** tool. Then select the quadratic graph by clicking on it with ⬚, you will then be prompted to select a lower bound my moving the cursor somewhere to the left of the desired root and click (⬚) and then to the right of the root and click again (⬚).



There are number of features that can be identified using the Analyse Graph tool, spend some time exploring the other options available by pressing menu 6.



Manually Moving Graphs

You saw earlier that, when you change a function's equation the graph changes. An innovative feature of TI-Nspire is that you can also do the reverse, i.e. manually manipulate the graph and see the function's equation change. As the graph moves, all associated features such as points of intersection and their coordinates also update.

First move the straight line graph, as follows.

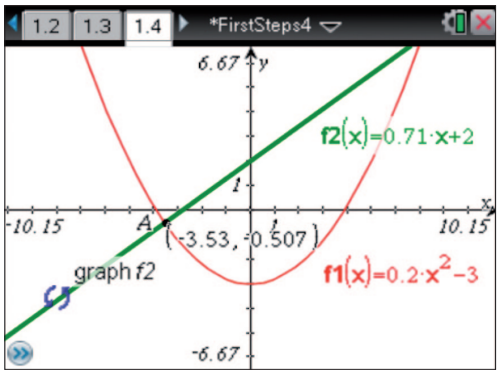
Check that no icons are still showing in the top left corner of the work area (press esc if there is anything displayed) and then move the pointer to the graph of the function ***f2(x)=x+2***.

Alternative icons

The line should be highlighted and you will see one of the two icons shown here, depending on where exactly you are on the screen. Move along the line and you will discover the other icon.

Near the middle of the graph the icon suggesting *translation* appears, while the one suggesting *rotation* appears towards the ends of the graph. Decide which you would like to use and grab the line by pressing and holding ctrl.

Use the Touchpad to move the graph around. Notice the way that the function's equation updates too.



Transformed graph and equation

Press esc and try the other transformation.

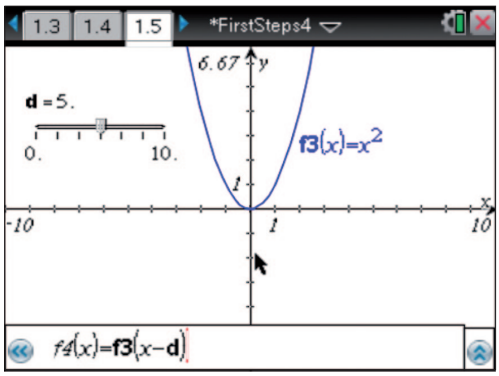
> Try manipulating a quadratic graph, and explore the possible transformations available

Many of the techniques that have been introduced in this tutorial, in particular fixing points, grabbing and labelling them, will be used again in Tutorial 5. In Tutorials 6 and 7 you will see how the Lists and Spreadsheets application allows tables of values to be formed from functions defined in the Graphs application.

Using Sliders

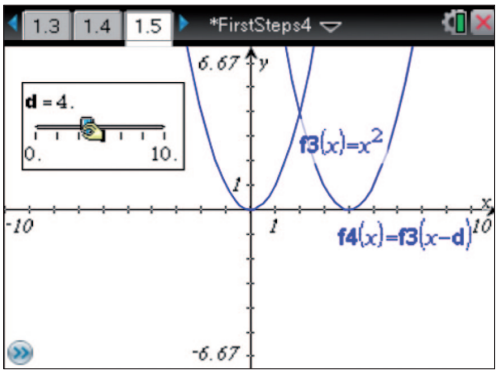
Sliders are a powerful way of controlling the value of constants in a graph or geometric construction. In this example we will use a slider to explore the transformation of a function. To do this, start by creating a new Graphs page by pressing ctrl on then selecting .

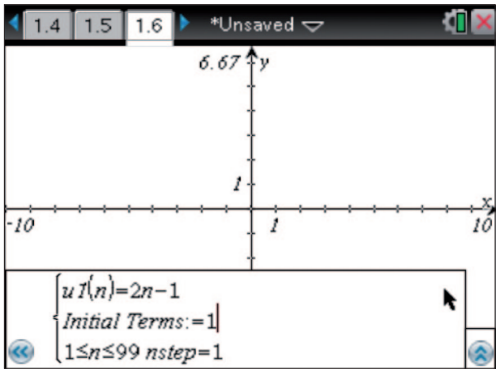
First enter the function ***f3(x)=x²***, then insert a slider by pressing menu 1 A. v1 will be highlighted. Change it to **d** by pressing D enter enter.



Next add a second function ***f4(x)=f3(x-d)*** by pressing tab F 3 (X − D) enter, this function is a transformation of the original function by **d**. Now grab the handle on the slider and move it left and right and observe the effect on the graph.

Try changing the original function, or moving the position of **d** in ***f4*** to explore other transformations.



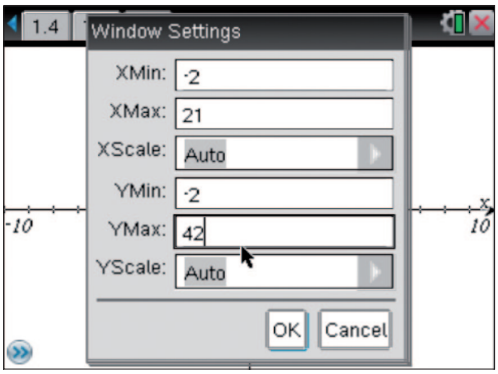


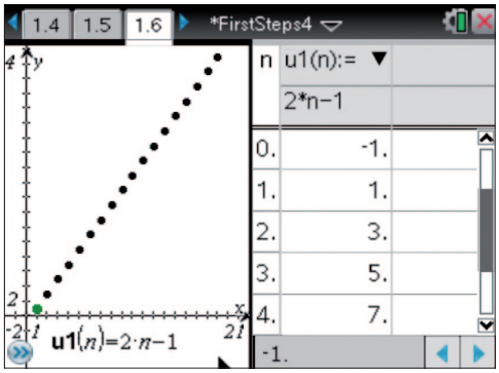
Sequence Plotting

We normally think of sequences as being lists of numbers, but sometimes it is useful to look at them graphically. The TI-Nspire makes this easy with the aid of its sequence plotting mode. To do this, create a new Graphs page by pressing on then selecting .

Then press menu 3 5 1 to put the TI-Nspire in to sequence mode. Enter the nth term of the sequence as u1(n)=2n-1 and enter the Initial **Terms** as the first term in the sequence, **1**, and press enter.

Adjust the window setting by pressing menu 4 1 and change the x-axis to go from -2 to 21 and the y-axis to go from -2 to 42. Now you can explore the sequence further by using Graph Trace menu 5 1 or by displaying the sequence as a table by pressing ctrl T.





You can also use the sequence plotter to explore recursive sequences. For example you could instead define ***u1(n)=u1(n-1)+u1(n-2)*** and set the **Initial Terms** set to **1,1** (1 , 1) which would give you a Fibonacci sequence.

Finally save the document as **FirstSteps5** so that you can refer to these graphs later.

Check list of some key points in Tutorial 4:

- Items visible in the graphing view: the work area, the entry line, the function history, the warning icons in the top-left corner
- Grabbing and dragging labels
- Setting the axes in three ways: by dragging, zooming and entering values
- Tracing along graphs
- Marking and labelling points and their coordinates
- Using the Analyse Graph menu
- Transforming graphs and their functions manually
- Using Sliders

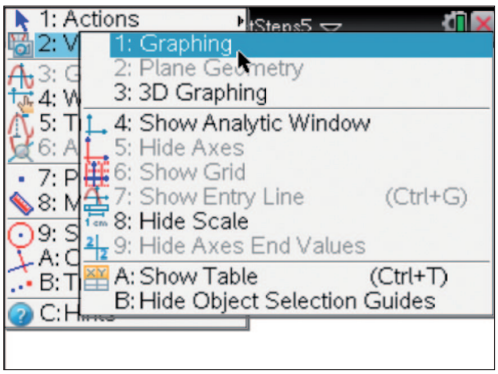
Tutorial 5

Geometry

This tutorial introduces interactive geometry in TI-Nspire and builds upon the methods and features of the Graphs and Geometry applications that were covered in Tutorial 4. You are led step by step through a geometrical construction which illustrates the simple concept that the areas of triangles with a fixed base and constant height are equal. As you work through the construction you will meet many of the features that make this one of the most powerful and attractive components of TI-Nspire.

A View for Plane Geometry

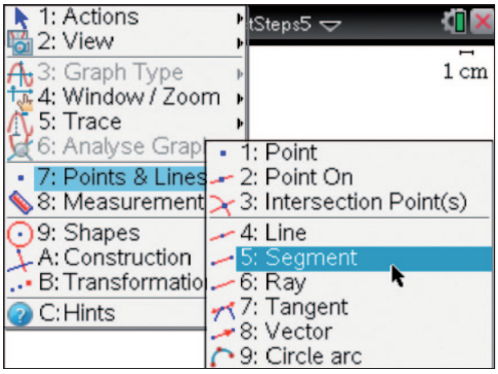
If necessary open your FirstSteps5 document and use the on key then select to create a new Geometry page.



Much like with a Graphing page it is possible to convert the Plane Geometry page in to a Graphing page by selecting menu 2 1. However for now leave the page in **Plane Geometry View**.

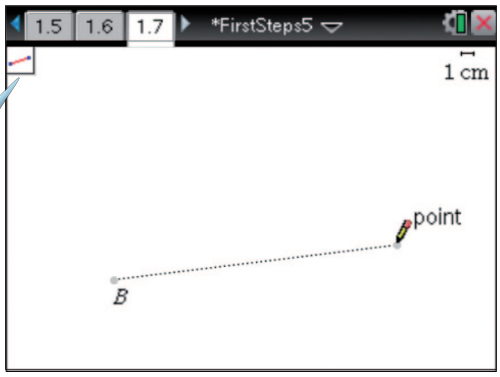
Two Parallel Lines

We will start by drawing a line segment to represent the base of a triangle and labelling it *BC*: press menu 7 to see the options available for drawing Points & Lines. Segments have two distinct end points, lines are (in theory) infinite, while rays have just one end. So choose option **5: Segment**.



Move the cursor to a suitable position for point B. Then click (⬚) to fix the point and then shift B to give it a label of **B**.

Move the cursor to where you want the other end of the segment to be. Mark the point and label it C in the same way. The icon in the top left corner is still showing you that you could draw another segment if you wish. Press esc to remove the icon and leave that mode of operation.



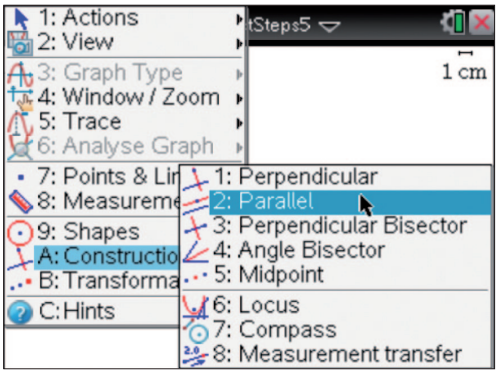
Notice that as usual the relevant icon appears in the top left corner of the screen.

Drawing the base of the triangle

The next step is to draw a line parallel to BC. This is a *construction* so you need to press menu A.

Choose option **2: Parallel.**

You must specify two things: the line to which it is to be parallel, and a point the line must pass though (although these can be chosen in either order). So move the cursor to the segment BC—you will see its label when you are in the right position. Click (⍾) to select the segment, move away, dragging a dotted parallel line and when happy with its position click again. Once again, don't forget to press esc, if you do not want to add another parallel line.



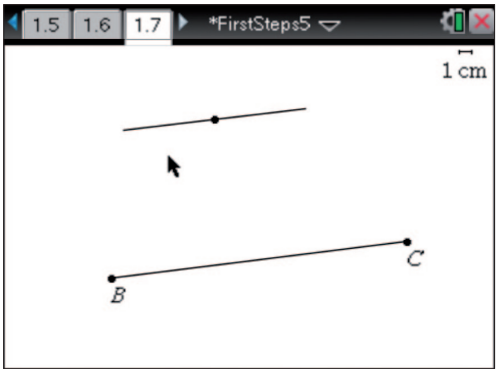
Many options in the Construction menu

What's grabbable?

At this point it is worth moving the cursor around the screen to see which objects can be grabbed and dragged.

You should see the open hand cursor (✋) appear for point B, for point C, for the segment BC, and for the point fixing the parallel line. All of these are grabbable.

However, the parallel line itself cannot be grabbed and dragged. It can however be selected for various purposes. For example, you could delete it by clicking (⍾) to select it and then pressing del to remove it.

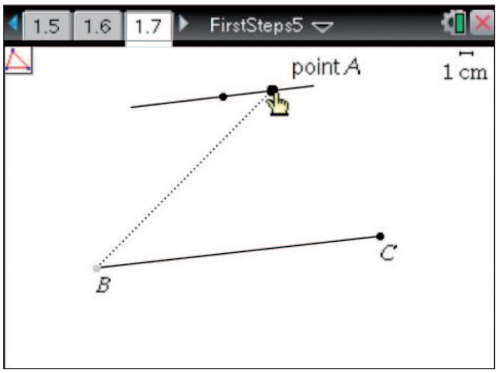


Selectable, but not grabbable!

Construct the Triangle

First, a point A is needed on the parallel line. Later you will be sliding this point along the line without moving the line itself, so the point that you have already which defines the line is not a good one to use. Therefore press menu 7 2 to select the option: **Point On**. Move the cursor to a new position on the line and then click (⍾) then press: shift A esc. The triangle itself can be constructed using the Shapes menu (menu 9 2). Check that the correct icon is showing in the top left corner, and then carefully select, in any order, each of the points A, B and C.

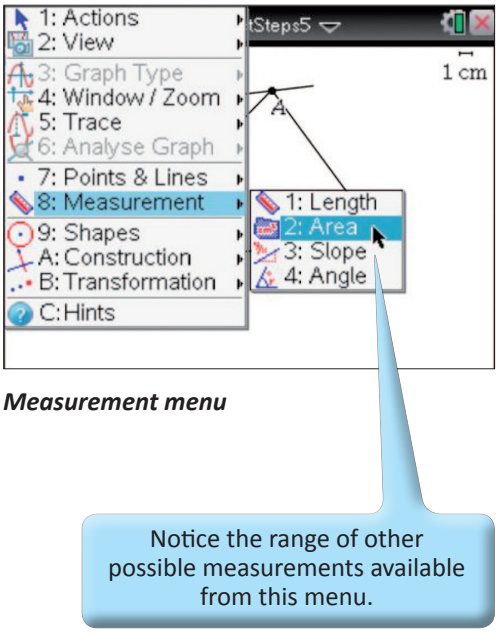
Make certain you don't click until its label and the pointing-finger icon appears as shown here.



Point A is ready to be selected

Making Measurements

With a triangle drawn on your screen, the next step is to measure its area. Choose option **2: Area** from the Measurement menu (menu 8) and then move the cursor to one of the sides of the triangle. The triangle label and the pointing-finger icon appear together with a calculated area in the background. Click to confirm the choice of the triangle, then move your cursor to where you want the measurement displayed then click again to show the measurement and finally press esc to remove the icon from the top left corner.



Measurement menu

The area is now displayed (to the number of significant figures set in the **Graphs & Geometry settings** doc 7 2 2).

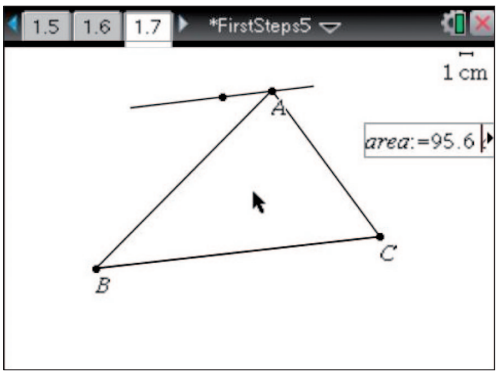
Remember you can place the cursor over the calculated value (you should see the open-hand icon) and press + or − several times. The effect is to reduce the number of displayed decimal places. This feature can be applied to any numbers on the screen in either the Graph or Geometry application.

Variables and Text

There are two ways to make it clear that the measurement at the bottom of the screen represents an area. One method is to simply add some text alongside the measurement. However, a more powerful method is to allocate the measurement to a variable and display the variable name alongside it. To do this:

- move the cursor over the measurement (you will see the open-hand icon;
- press var and choose option **1: Store Var** (Alternatively press ctrl var)
- use the alphabetic keys to give the variable the name "*area*". Press enter.

This variable may now be used on other pages of the document. For example, if you move to a Calculator page, type and enter *area*, the current value of the area will be used.



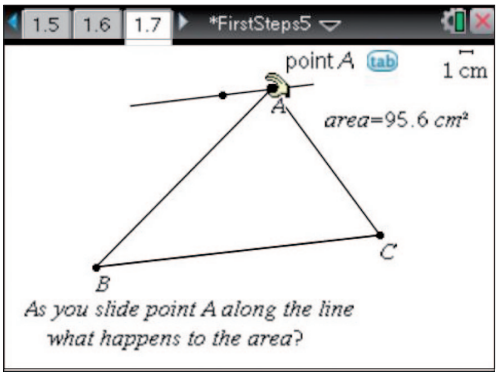
Storing the measurement as a variable

Now move to the top of the screen and enter some text, perhaps giving the user some explanation or instructions. You will need to press:

- menu 1 6 to select the Text option,
- Then click to start a box where text can be entered.
- Note you cannot do carriage returns in text boxes so do put in two lines you must use two text boxes!

Dynamic Changes

If you haven't yet done so, try grabbing point A and sliding it along its line. Make quite certain that you grab the point—you must see its label. You may need to press tab until the point itself, rather than the triangle or label is selected. If you do select the wrong item it is well worth remembering that ctrl esc will undo any action if something happens that you didn't intend!



Ready to grab A and slide it

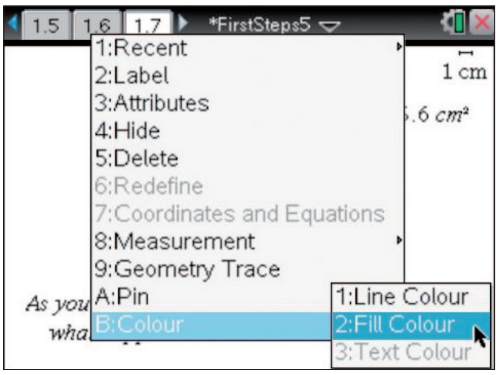
Notice that as you move the point, two sides of the triangle and the label A all move too. What does not change however, is the area.

Now try grabbing and dragging point B or C, and then the line segment BC and the line parallel to it. In each case notice which other items on the screen move, and which do not. Thinking about how each item was originally defined should explain whether it moves in relation to other items.

Tidying Up and Using Attributes

Finally it's well worth seeing how to improve the appearance of the screen and preventing items from being grabbed unintentionally.

For this activity the scale in the top right corner may not be needed. You can hide it with option 8 in the View menu. The point that defines the parallel line may be rather distracting, so you could hide it using option 3 in the Actions menu.



Changing the attributes of the triangle

Now from the Actions menu choose option **4: Attributes**. Move the cursor to one of the sides of the triangle and click (⍾) to select it.

This allows you to change the thickness and style of the line. Press enter to confirm your choices.

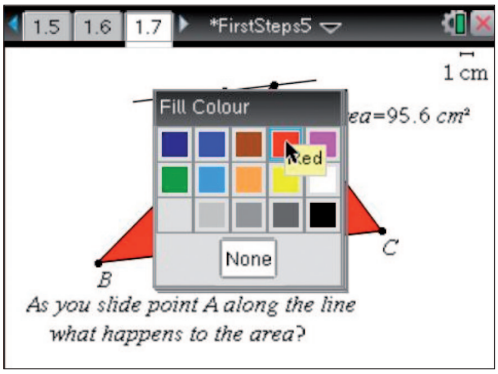
To change the shading of the shape, you need to 'right-click' on the triangle by placing the cursor over one of the edges and pressing ctrl menu.

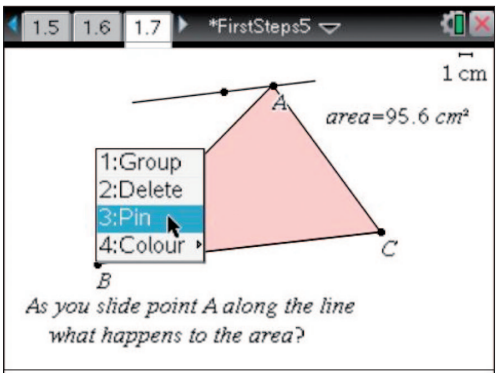
This brings up the **contextual menu** which gives the options available for the option displayed. To change the shading select **Colour** then **Line Colour** or **Fill Colour** which will open a colour picker from which you can choose a colour.

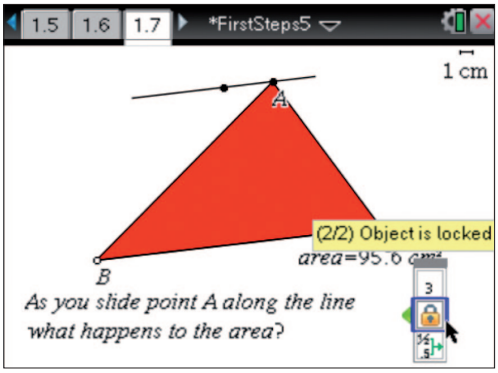
Now move the cursor to point B and right click again (ctrl menu). This gives you the contextual menu for the point, one option here is to **Pin** the point, which will prevent users from grabbing and moving it. For example, there may be good pedagogic reasons for only allowing point A to move in this activity. For the moment pin points B and C.

To unpin an object just right-click on the object again and select **Unpin**.

Continue to move the cursor around the screen and see the options for changing the attributes of the parallel line and also the area measurement. When you look at the attributes for the area calculation you will see the option of a padlock. Locking the measurement will fix the current value constraining movement of other points accordingly.







Area is now locked

Locking some objects and unlocking others can have very interesting effects and if you have time you may care to investigate the following situations.

a) **Locked/Pinned:** The area measurement.
Unlocked/Unpinned: Points B and C and the parallel line through A.
Try Moving point B

b) **Locked/Pinned:** The area measurement and the parallel line through A.
Unlocked/Unpinned: Points B and C.
Try Moving point B

Once again save your document as **FirstSteps6** before going any further.

Check list of some key points in Tutorial 5:

- Use of the Plane Geometry View rather than the Graphing View
- Lines, segments and rays
- Constructing parallel lines
- Drawing points on objects and labelling them
- The construction of shapes
- The difference between selecting and grabbing screen objects
- Making a measurement and storing as a variable
- Attributes which change the appearance and locking/pinning screen objects

Tutorial 6

Lists & Spreadsheet

The Lists & Spreadsheet application is a very powerful means of manipulating data lists and works seamlessly with the other applications to provide multiple representations of data. This tutorial introduces the application, showing how to use it as a simple spreadsheet. It also shows how the Lists & Spreadsheet application handles lists and functions defined in the Calculator, and Graphs applications.
In the next Tutorial you will see how Lists & Spreadsheet is used in conjunction with the Data & Statistics application to produce charts and statistical summaries.

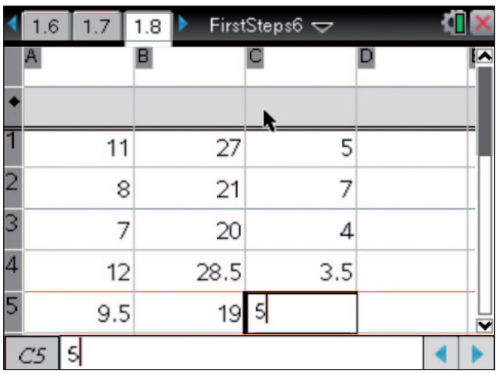
Entering Data as Lists

Open a document and press [on] then select to add a new page using the Lists & Spreadsheet application.

Enter some data similar to that shown here:

- column A represents male shoe sizes,
- column B has widths of hand spans in cm (paired data with column A),
- column C is female shoe sizes.

You will need 20 or 30 pairs of similar data in columns A and B and at least 15 values in column C.



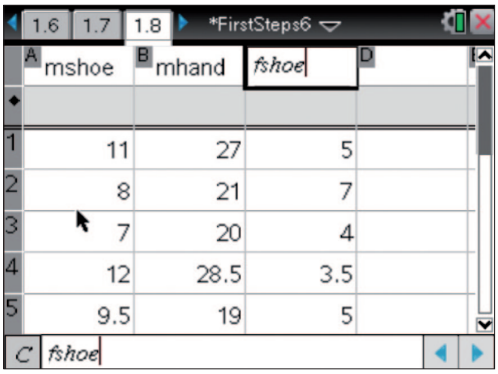
Differences from a spreadsheet?

Notice the similarities and differences between this screen and a traditional spreadsheet. In particular notice the two areas coloured white and grey at the top of each column.

- The white area is for list names.
- The grey area is for formulas that will apply to all items in the list below.

Move to the white space beside A, type **mshoe** and press [enter].

What you have just done is to define a new list. If you were to move to a Calculator screen, pressing [var] would reveal **mshoe** as one of the defined variables and lists, and entering the name on that screen would produce the result {11,8,7,12,9.5,.....}



Defining the list in column C

Lists can also be defined in the Calculator application

Define the data in columns B and C as lists **mhand** and **fshoe**.

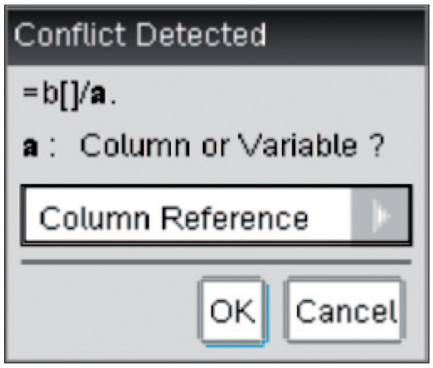
Using Formulae

Suppose you wished to investigate the relationship between hand spans and shoe sizes. You might therefore wish to divide every hand-span measurement by the corresponding shoe size. These ratios would best be expressed in decimal rather than fractional format so change the Document Settings for Calculation Mode to Approximate (doc 7 2 1).

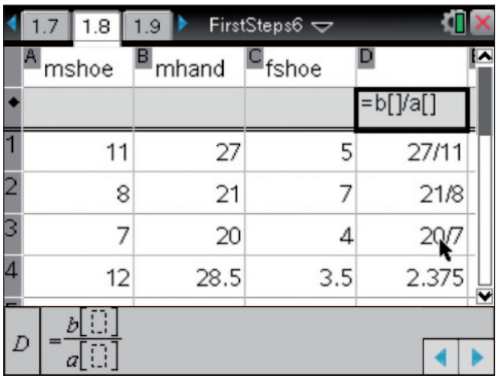
There are 3 ways (at least!) of calculating the ratios on the TI-Nspire. Try one of the following now.

Either: in cell D1 type the expression =B1/A1. Select D1 and fill down the column by pressing menu and choosing the options **3: Data** and **3: Fill Down**.

Or: in the grey formula area at the top of column D enter **=mhand/mshoe**.
Or: in the grey formula area enter **=b/a**.



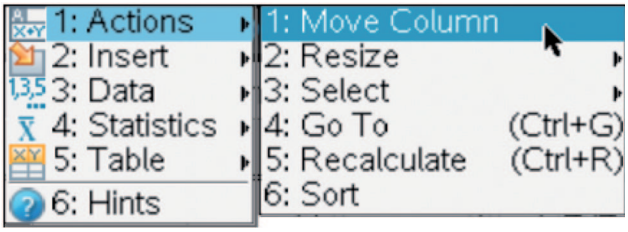
Conflict resolution



One way to enter a formula

Press menu and notice the various options available in the **Lists & Spreadsheet** application.

TI-Nspire has most of the editing features that you would expect from a spreadsheet including selecting, inserting, moving and deleting rows, columns and cells.



Typical Spreadsheet Actions

You can also create absolute cell references in the usual way using $ chosen from the symbols key menu (?!) and you can sort data in columns (menu 1 6). To sort multiple columns at once by one column press ▲ until the column is selected then hold down shift and press ◀ or ▶ to select the columns you want before choosing Sort from the **Actions** menu.

Capturing Data

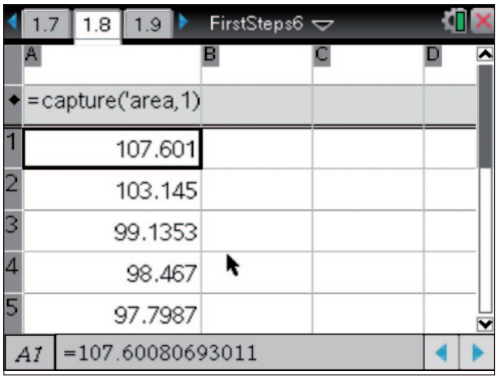
A powerful feature of TI-Nspire is its ability to capture data from a **Graphs** or **Geometry** page. Follow through these steps to see an example of how this works, using the measurement of the area of a triangle from Tutorial 5.

- Create a new **Lists & Spreadsheet** page: (on then select).
- Choose the Manual Data Capture option from the menus (menu 3 2 2).
  You should see in the entry line: ***=capture(var,0)***.
- Overtype *var* by typing the variable name area.
- Resize the column (menu 1 2 1).
- Move to cell A1 and capture the current value of area by pressing ctrl .
- Move to the page where you constructed the triangle. If necessary unpin point B and unlock the area variable, then grab B and move it. Notice that this changes the area.
- Return to page 1.6 and in cell A2 press ctrl .

Instead of typing 'area' you can also press var, highlight area and then press enter.

In the formula the second parameter, 0, indicates manual capture was selected. An interesting variation involves using automatic capture (i.e. ***=capture(area,1)***). Either edit the formula in column A or enter it in column B (menu 3 2 1). Then grab and move point B around again and see the huge amount of data that are generated. (See the Appendix for more ideas about using this feature).

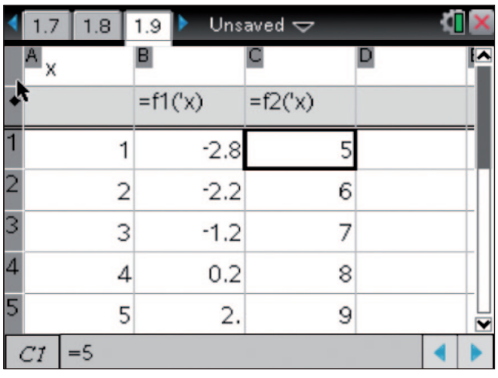
If you have time you may care to measure the base and height of the triangle on the Geometry page and capture these values on the Spreadsheet page. How could such features be used to develop an understanding of triangle area?
Capturing data by hand



Capturing data by hand

Function Tables

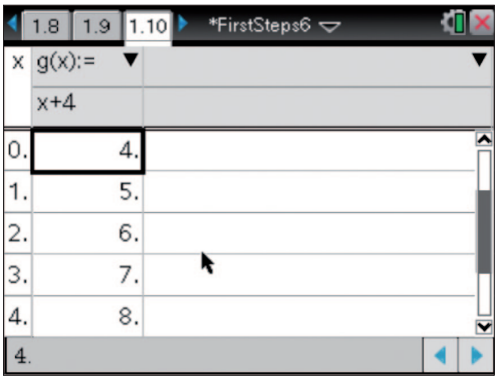
It is quite possible to create from scratch a table of values for functions that have been defined elsewhere in the current document. For example, the screen shown here uses the definitions of ***f1*** and ***f2*** that were used previously. Don't worry if the values you see are different from these.



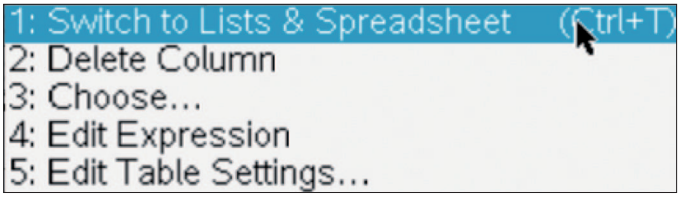
A hand-made function table

Because function tables are so useful, they can also be drawn automatically. Follow through these steps.

- Create another **Lists & Spreadsheet** page and press menu 5 1 to switch to a function table. Notice the different layout of the screen and a box with a list of the currently defined functions.
- Choose a function and scroll up and down.
- Press menu 5 again. These are the only options that are available now: apart from the ability to resize columns.
- Experiment with using option **5: Edit Table Settings**.
- Now use option **4: Edit Expression**. You will see the values in the table change and any associated function will also have changed.



A simple function table



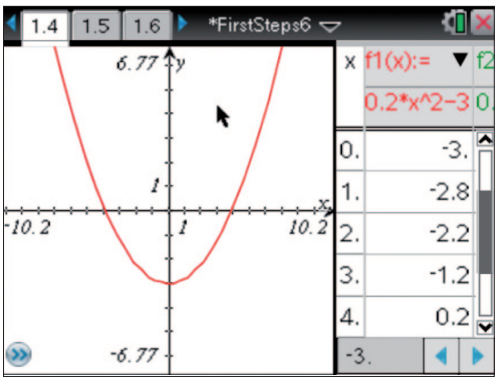
Options for function tables

Having a function's table on the same page as its graph can clearly be a powerful learning tool and there is a very simple way of arranging this on a split screen. On the relevant page of your document choose option A in the View menu or press ctrl T.

The Function Table view is an alternative for any Lists & Spreadsheet page. You can toggle between the two views using ctrl T.

With a split screen of this nature it is as well to remove all unnecessary clutter. Here the labels and unnecessary functions have been deleted. Also the vertical split between graph and table was set using the option **Custom Split** from the Documents/Page layout menu. (doc 5 1).

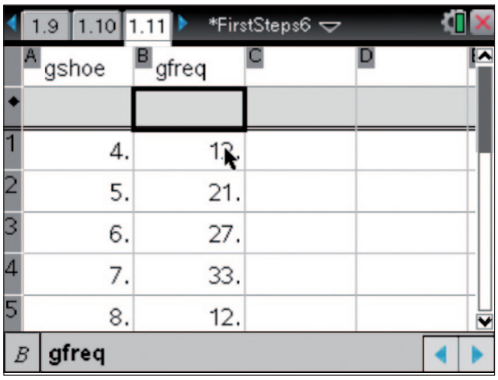
You can refine the split further by pressing the outer edge of the touchpad to move the window separator and then press enter.



Graph and table side by side

Frequency Charts

Often due to the quantity of data it is more useful to work with data in the form of a frequency chart, this can be for either discrete or grouped data (using the midpoint). Let's look at some more shoe size data but this time as a frequency chart. Create a new **Lists & Spreadsheet** page, then enter the following data, with the headings **gshoe** (grouped shoe size) and **gfreq** (grouped frequency). We'll explore what we can do with this data in the next section!



Once again save your document, now as **FirstSteps7** before going any further.

Check list of some key points in Tutorial 6:

- Entering and editing data and formulas
- Lists and functions defined in other sections of the document
- Resizing cells
- Coping with ambiguous variable/cell names
- Use of function tables
- Entering Frequency Tables

Tutorial 7

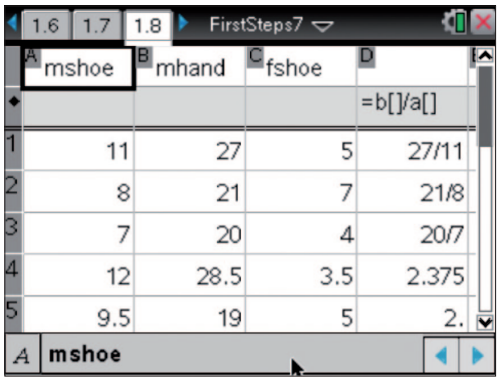
One and Two Variable Statistics

One of the six core applications of TI-Nspire is Data & Statistics, the workspace for presenting, interpreting and manipulating statistical charts and graphs. This application works in combination with the Lists & Spreadsheet application and this tutorial uses the data that were entered as a spreadsheet at the beginning of Tutorial 6.

Shoe Sizes and Hand Spans

Start by locating in your Document the page that you created in the first part of Tutorial 6. There should be 20 or 30 pairs of (probably fictitious) data in columns A and B and at least 15 values in column C.

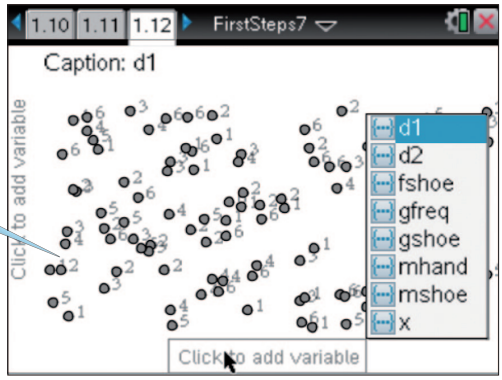
- List **mshoe** in column A represents male shoe sizes.
- List **mhand** in column B has widths of hand spans in cm (paired data with column A).
- List **fshoe** in column C represents female shoe sizes.



Data entered in Tutorial 6

Charts with One Variable

To create a new page for the charts press [on] then select .



Randomly distributed points: no variables have yet been assigned.

Choosing a variable

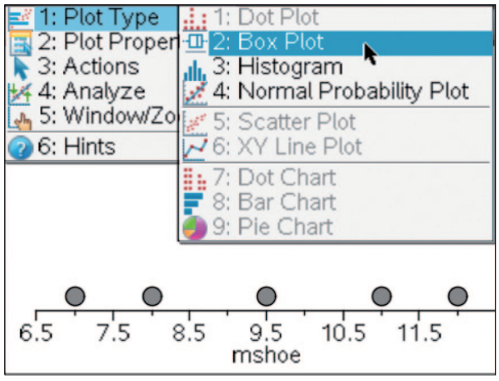
Move the cursor to the bottom of the screen where it says: Click to add variable. Press [ctrl].

A list of currently defined lists opens up, so use the Touchpad to select **mshoe** and press [enter] or [ctrl].

Initially you will see a dot plot.

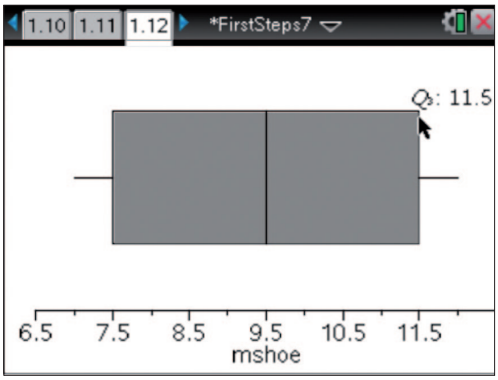
Press [menu] [1] to see the Plot Type menu, which gives nine types of plot. Because you have only defined a single numerical variable so far, there are only three alternative plots including a boxplot and a histogram.

Try these options now.



Three plots for numerical data

Display the boxplot and then move the cursor over the chart. You will be able to see the median, quartiles, maximum and minimum values and, possibly, outlier values.



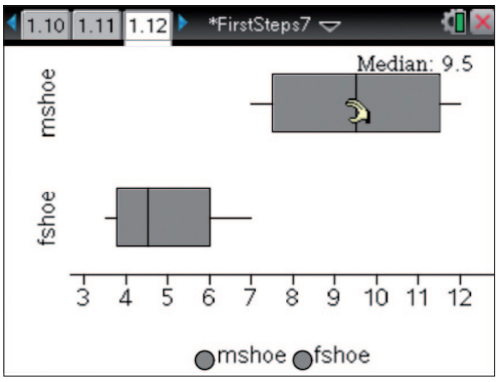
Upper quartile displayed

Comparing Boxplots

This boxplot can be compared with a similar one representing the female shoe sizes by displaying them, one above another. To do this we add a second **X Variable** by pressing menu 2 4, this will give you the choice of available lists.

This time select **fshoe**. The result is two side by side box plots that can easily be compared.

This method can be used to add more box plots, up to five or six can be easily compared on the same screen.



Comparing shoe sizes

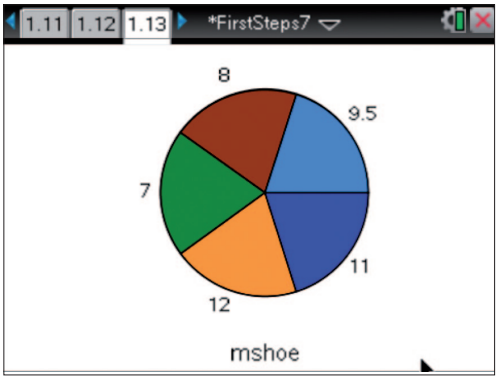
Charts for Categorical Data

Create a new Data & Statistics page and choose the variable *mshoe* for the x axis.

This variable contains a list of numerical data but they could also be thought of as categorical data, in which case it would be appropriate to use a Pie Chart. By using the option **Force Categorical X** in the Plot Properties menu you can force the handheld to treat the data in this way. Notice the way in which the labels on the axis change.

Now you can use the Plot Type menu to choose Pie Chart.

It is also possible to enter non-numerical categorical data in a **Lists & Spreadsheet** page, e.g., favourite pets, sandwich fillings etc. Such data must be entered in quotation marks by pressing ctrl × ("").



A Pie Chart displaying categorical data

Charts with Two Variables

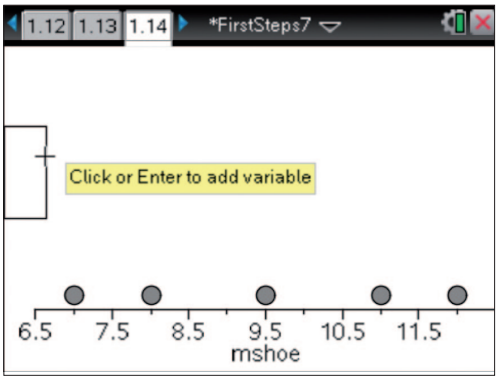
Create a new **Data & Statistics** page.

Notice both axes are marked *Click to add variable*.

As before select **mshoe** for the horizontal axis.

Move the cursor to the left edge of the screen, click ⬚ and select the variable **mhand** for the vertical axis.

This displays the scatterplot.

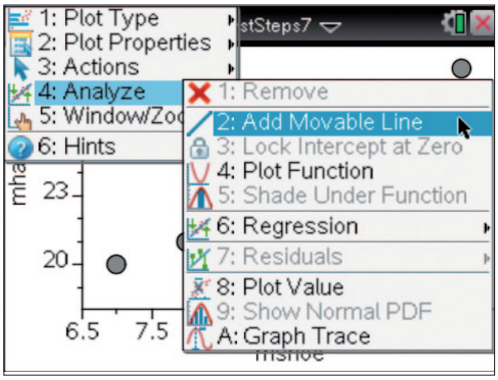


Ready to add a 2nd variable

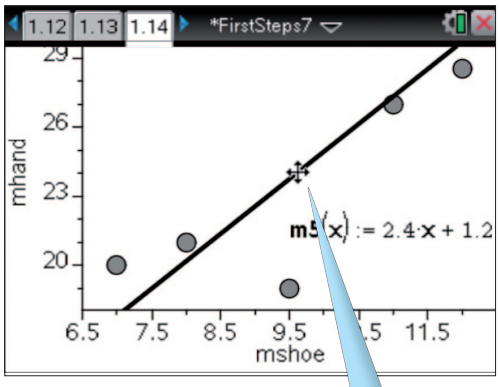
It may be that there is a positive correlation and a relationship between hand span and shoe size, so it may be appropriate to model this relationship with a linear function. The Analyze menu provides a range of tools to use.

Fitting a Line by Hand and Eye

First try adding a line of best fit by eye, using option **2: Add Movable Line**. This displays a straight line together with a functional relationship between mshoe and mhand. The line can be dragged into a best-fit position using the two cursors for rotate and translate, in exactly the same way as a straight line can be moved manually in the Graphs and Geometry applications.

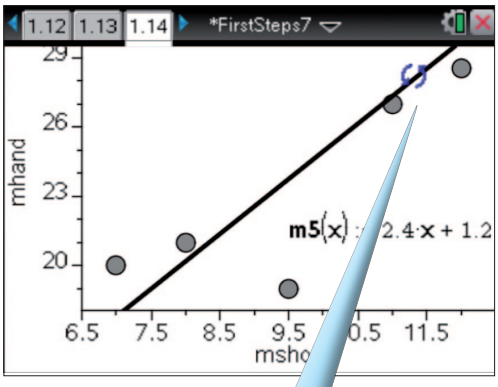


Powerful options in the Analyse menu



Translating the line

Move to the middle of the line to get the translate cursor. Click and hold ⬚ to grab it. Now move the line into position. Click again ⬚ to release the cursor.



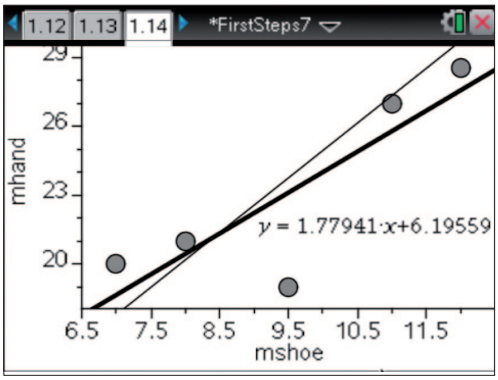
Rotating the line

Move towards one end of the line to show the rotate cursor. Click and hold ⬚ to grab it. Use the Touchpad to rotate the line. Click again ⬚ to release the cursor.

Drawing the Regression Line

The line that was fitted by hand and eye can be compared with the calculated linear regression line using option 4 in the Analyze menu. Pressing menu 4 6 1 will display a line with equation of the form y=mx+b.

As usual, you can click and drag on the regression equation to move it to a convenient place.



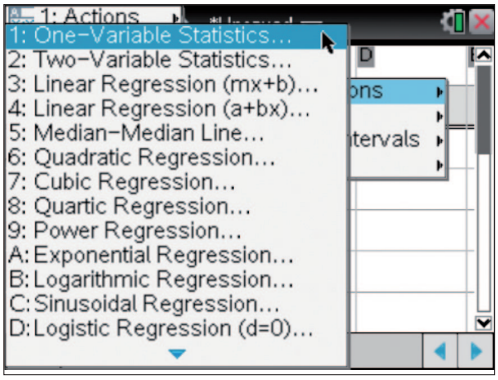
The calculated regression line

Getting the Stats

There are two methods for displaying summary statistics:

1. For a single statistic you can type its name and use the var key to choose the variable, e.g. =median(fshoe).
   = M E D I A N (var enter
2. On a **Lists & Spreadsheet** page, you can enter a complete set of statistics into spreadsheet cells.

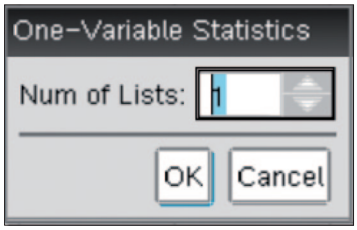
Open a new **Lists & Spreadsheet** page and press menu 4 1 to see the range of statistical calculations. (Once again these will be very familiar to users of the TI-83/4).



The Statistics Calculations menu

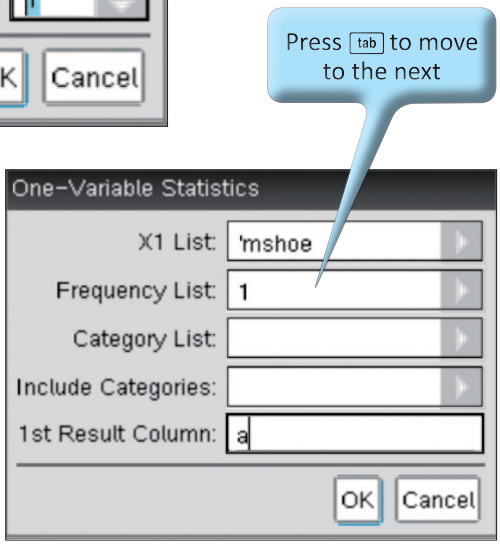
Choose option **1: One-Variable Statistics**.

You have the option to display stats for more than one list but for now choose 1 list and then OK.

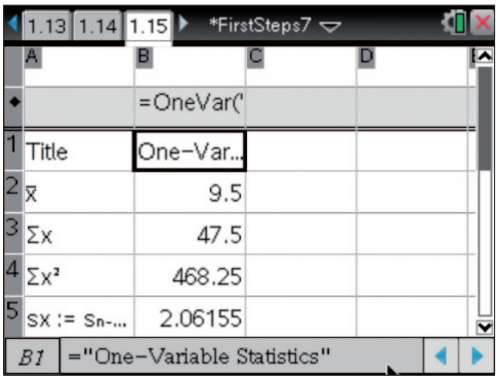


Choosing the data list can either be done using the Touchpad, or you can type the name.

Type the letter of the column where you want the results to appear.



It is also possible to arrange side-by-side comparisons of corresponding summary statistics for two or more data sets and this makes drawing inferences from the statistics very quick and very clear. The best way to do this is to select more than one list above.

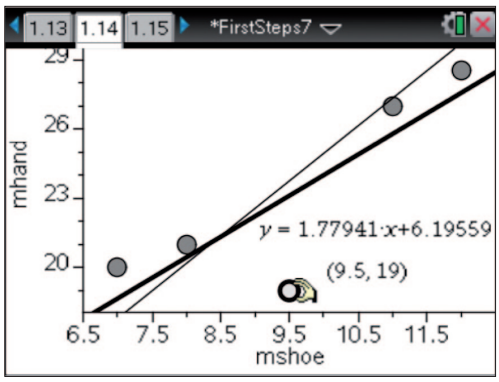


Sets of statistics

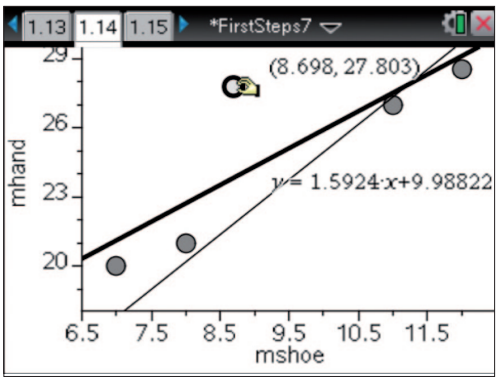
Dragging on the Charts

An interesting feature is the ability to drag plotted points around charts, thus changing the original data. Go back to the page on which you created the scatterplot for male hand spans and shoe sizes. You left the plot showing the y=mx+b regression line and equation.

Move the cursor to a point very near the line of best fit. The cursor changes to a hand with a finger pointing upwards when it is pointing to a data point. Click and hold .
Move the cursor to investigate the effect that moving this point has on the regression line. Below, the point has been moved to the top of the screen for maximum effect.



The effect of moving a point from here …



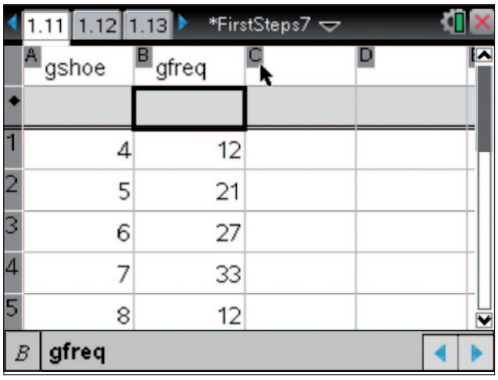
… to here.

This shows the effect of changing a single hand-span value from 21cm to 32cm

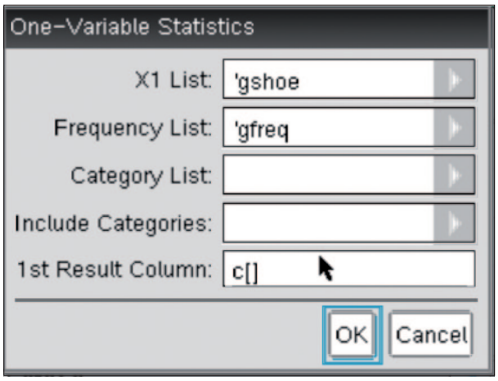
Working with Frequency Data

In the previous tutorial we entered some grouped data for shoe sizes. We will now explore some of the ways we can work with that data using TI-Nspire. Start by returning to the **Lists & Spreadsheet** page we created in the previous tutorial.

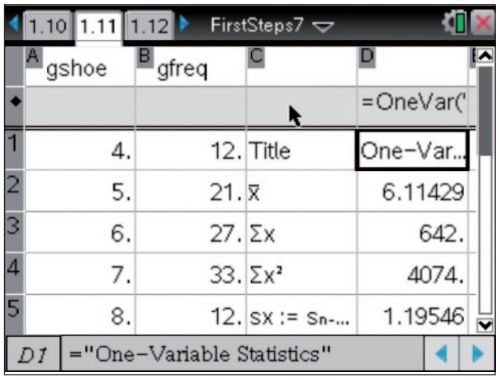
We can use the same process we used above to find summary statistics for this frequency data.



Press menu 4 1 1 to start the **One-Variable Statistics** wizard, again choose 1 list (remember multiple lists are for when you want to calculate statistics for multiple lists at the same time).

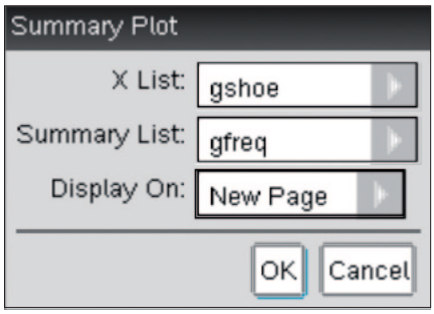


This time we set the X1 List to be **'gshoe** but change the **Frequency List** from 1 to **'gfreq**, and set the Results Column to be **c** (which is the first empty column).

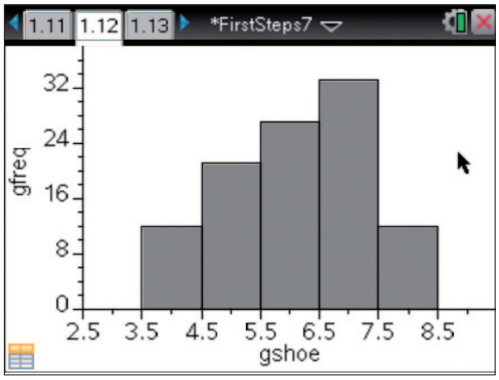


This gives you the summary statistics for this grouped data – Notice the mean comes out of to be just over 6, which matches original data (as the shoe-sizes go from 4 to 8).

We can also graph this data. This can be achieved from either the **Lists & Spreadsheet** page by pressing menu 3 5 to insert a **Summary Plot**, or from a Data and Statistics page by pressing menu 2 5 to insert an **X Variable with Frequency**. We will use this second approach now, so create a new Data and Statics page by pressing c then selecting .

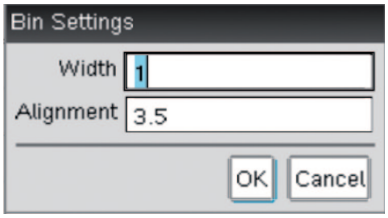


Then press menu 2 5, this will give you the Frequency Plot wizard.



This will give you the following graph. This can also be displayed as a box plot by pressing menu 1 2.

If you are dealing with grouped data you may need to adjust the **Bin Settings** by pressing menu 2 2 2.



Save your document as FirstStepsComplete, so you can return to this if you want at a later date.

Check list of some key points in Tutorial 7

- Creating one- and two-variable statistical plots in the Data & Statistics application
- Plotting categorical as opposed to numerical data
- Using boxplots to compare data sets
- Calculating and displaying summary statistics
- Manually fitting straight lines to data
- Automatically fitting linear-regression lines to data
- Dragging points on a scatterplot
- Working with Frequency Data

Appendix

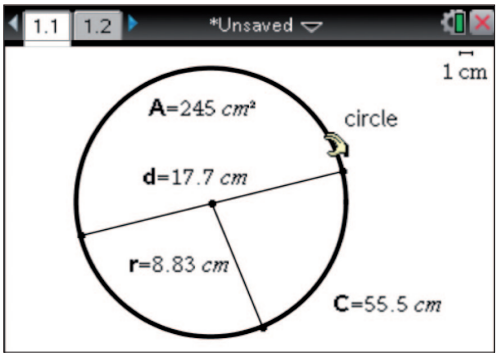
Multiple Representations

The previous seven tutorials have introduced many of the key features of TI-Nspire learning technology, with each of the applications being discussed separately. However, one of the great strengths of TI-Nspire is that it allows the applications to be linked dynamically, encouraging different approaches to problem solving. This appendix offers an example of what is meant by "multiple representations", showing how several of the applications can be used to investigate a mathematical concept, in this case the relationship between a circle's diameter and circumference and between its radius and area.

By working through this appendix you will be able to revise many of the skills and techniques you met in the tutorials. Here detailed instructions and key presses have been omitted though you will find back references if you need to remind yourself about particular techniques. However, try to concentrate on the big picture of what is going on, asking yourself how each of the multiple representations contributes to a deeper understanding of the mathematics.

Draw and Measure a Circle

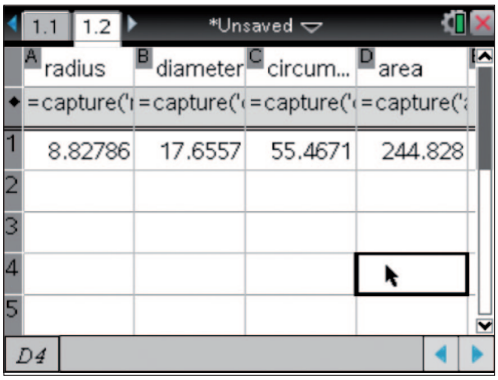
- Open a new document with a **Geometry** page.
- Construct a large circle on the screen.
- Construct a radius by drawing a **segment** from the centre to the circumference.
- To construct a diameter first construct a **line** (not a segment) from the centre to the circumference. Then construct the **Intersection Points** of the line and the circle: this generates the point on the opposite end of the diameter.
- Now measure the lengths of the radius, the diameter and the circumference. Also measure the area. In each case change the number of decimal points displayed.
- Finally assign the measurements to variables. Click on each measurement in turn. Press [var]. Type the letter appropriate for each measurement (**r**, **d**, **C** and **A**) and press [enter].
- Check that the measurements all change when you grab the edge of the circle and change its size.



A measured circle

A Spreadsheet for Data Capture

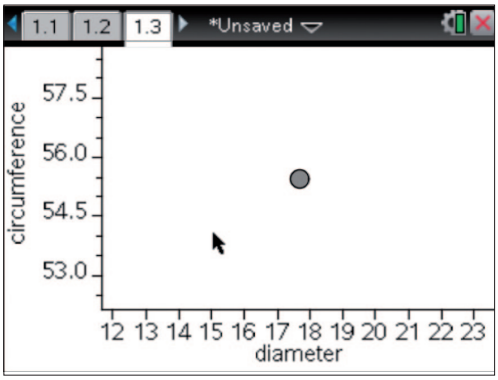
- Open a new **Lists & Spreadsheet** page.
- Type column headings for columns A to D.
- Click in the function entry line in column A (grey cell just below the heading).
- From the Data menu choose **Automated Data Capture**. Type **r** and press enter. This will capture values of the radius in column A.
- Repeat for the other variables in columns B to D.
- Check that the data that appear are the same as the current measurements on the previous page.



Beginning to capture data

Two Scatterplots

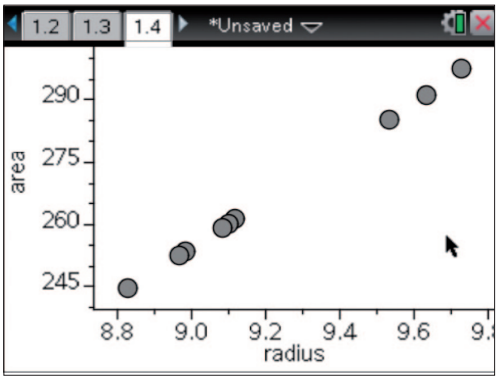
- Open a Data & Statistics page.
- Choose the variable **diameter** for the horizontal axis and **circum** for the vertical axis.
- So far there is only one data pair and one point for the Scatter Plot.
- Open another **Data & Statistics** page.
- Choose the variable **radius** for the horizontal axis and area for the vertical axis.



Setting up a scatter plot

Collecting Just a Little Data

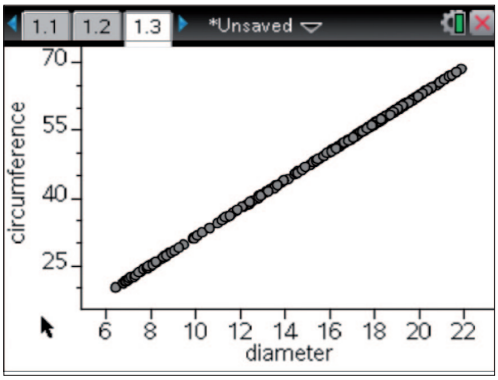
- Return to the **Geometry** page.
- Click and drag on the circumference of the circle to move it in and out ***just a little bit***.
- Review the amount of data you have collected in the spreadsheet.
- Review the relationships shown on the two scatter plots.
- You may need to update the window settings using the option **Zoom–Data** from the Window/Zoom menu - menu 5 2.



Data capture is under way

Go to Town with Data Collection

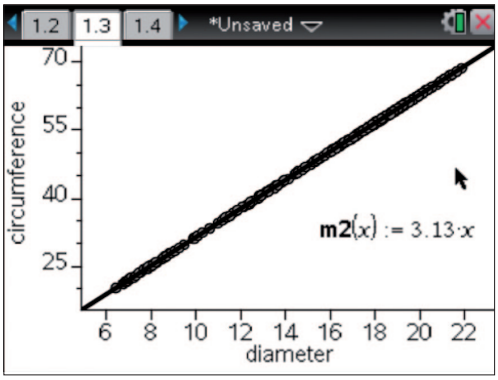
- Return to the **Geometry** page and drag the circumference in as far as you can.
- Review the data in the spreadsheet.
- Review the diameter/circumference scatter plot, using **Zoom–Data** to update the window settings.



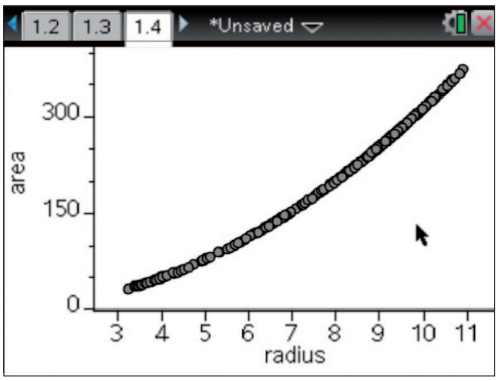
A linear relationship

Fit a Straight Line

- From the Analyze menu choose **Add Movable Line**. Drag it into place to fit the plotted points.
- To tidy the function, choose **Lock Intercept at Zero** from the Analyze menu.
- Also review the radius/area scatter plot. Using **Zoom–Data** here will create a dramatic change!



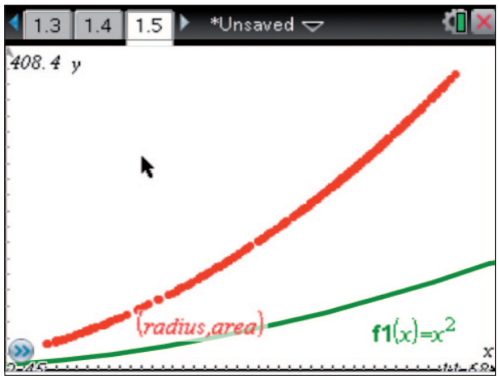
Moving a straight line by hand



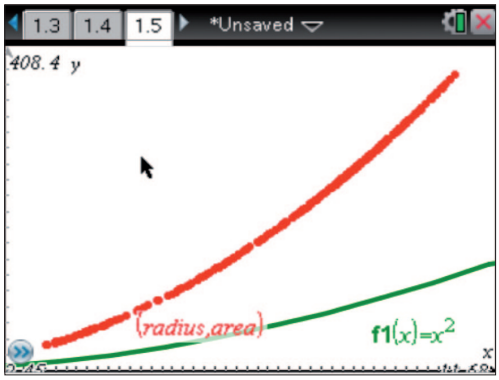
Not a linear relationship!

A Different Approach to Scatterplots

- Open a new **Graphs** page.
- From the Graph Type menu choose **Scatter Plot** – menu 3 4.
- Set x to be **radius** and y to be **area**.
- From the Window menu choose **Zoom–Data** and hide the entry line to gain a good view of the data points including the horizontal axis.
- Now choose **Function** from the Graph Type menu - menu 3 1.
- Enter ***f1(x)=x²***.
- Now you can click and drag the quadratic curve into place to fit the data, just as you did earlier for the straight line.



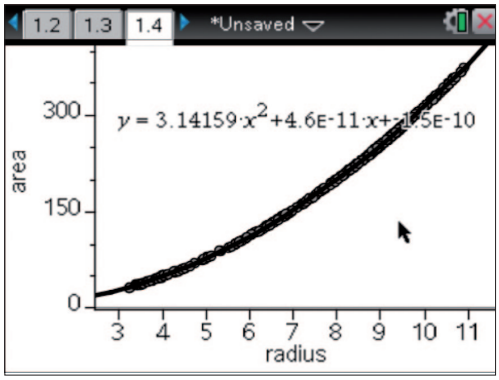
The basic quadratic ready for fitting…

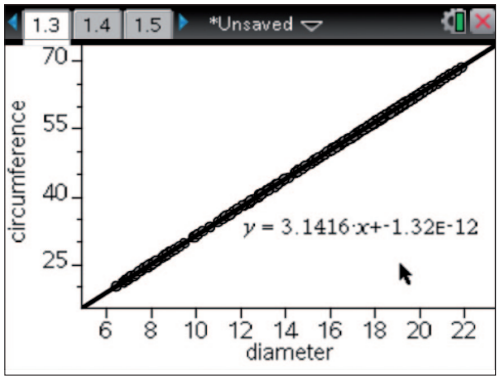


… and dragged into place

Regression

Go back to the each of the scatter plots on the **Data & Statistics** pages in turn. From the Analyze menu choose Regression and place appropriate lines on the data.





What other mathematical examples lend themselves to this sort of approach?